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CONTRIBUTION OF PLATFORM MOTION SIMULATION IN SH-3 HELICOPTER PILOT TRAINING

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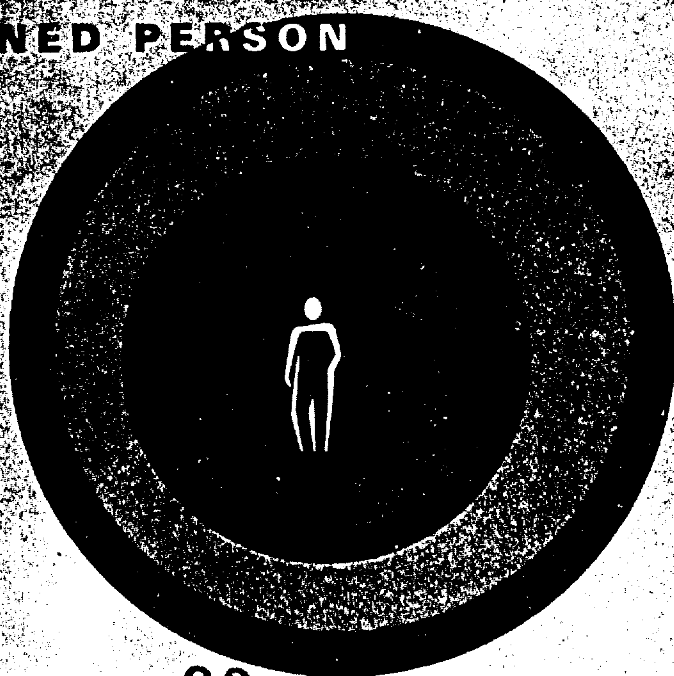

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TRAINING ANALYSIS AND EVALUATION GROUP
ORLANDO, FLORIDA 32813

Technical Report 153

CONTRIBUTION OF PLATFORM MOTION SIMULATION IN SH-3 HELICOPTER PILOT TRAINING

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The contribution of motion simulation on training devices to later performance in the aircraft has been a controversial issue. With the advent of high fidelity flight simulators, it was assumed that motion cues would increase the realism of the training environment and provide cues that would enable the aircrew to perform better in the simulator and in the aircraft. Few studies have addressed both results. The few that have, have been criticized due to later findings that the motion (Con't on reverse side)

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20. ABSTRACT (continued)

system in question had excessive lags and less than design accelerations. To insure against such criticisms and to accurately state the outcome of the transfer of training experiment, the motion system platform was instrumented and tested by engineers during the transfer experiment.

The inflight performance of a group of pilots trained in Device 2F64C with motion simulation was compared to that of a group trained under the same conditions but without motion simulation.

The measures used for comparison were:

- first-pilot hours required in the aircraft to complete A and/or B stage training
- aircraft trials to reach proficiency on selected tasks.

ACKNOWLEDGMENT

It is not possible to list all the personnel who contributed to the training effectiveness evaluation of Device 2F64C and to the unique engineering assessment of platform motion simulation that was concurrently accomplished. However, the contributions of the personnel listed below must be acknowledged.

Mr. Blair Browder and Mr. Steve Butrimas of the Visual Technology Research Simulator Branch of the Naval Training Equipment Center developed the engineering assessment plan, conducted the assessment and analyzed the data. Their report is included as appendix A.

LCDR L. D. Whitmer and Mr. M. F. Roscoe of the Rotary Wing Test Directorate of the Naval Air Test Center provided essential test equipment, aeronautical knowledge and participated in the device testing.

TDCS E. W. Walker, Chief in Charge of the HS Flight Tactics Division of the Fleet Aviation Specialized Operational Training Group, Atlantic Fleet, Detachment Jacksonville, provided excellent personnel and equipment support for the testing. TD2 R. L. Kifer also of the HS Flight Tactics Division provided the programming services required to support the engineering tests.

Dr. Mark Pfeiffer of TAEG assisted in the analysis of data collected during the transfer of training experiment and in reviewing the report for technical accuracy.

Dr. A. F. Smode, Director of TAEG, provided extensive support to the project. His substantial technical guidance and many fruitful discussions on organizing the findings have contributed significantly to the report.

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SUMMARY

A number of simulation features have been incorporated into military flight simulators in the belief that they add to the realism and, therefore, increase the training value (e.g., G-suit and G-seat simulation, visual dimming to simulate Gs). Motion simulation has been in this category; however, transfer of training studies have generally yielded inconclusive answers or lack of positive training value of motion for both multi-engine and fighter/attack simulators. Few studies have addressed the contribution of motion simulation to the training of helicopter pilots.

This is the second in a series of four studies designed to assess the training effectiveness of the Device 2F64C, SH-3 helicopter flight simulator. The overall program is concerned with evaluating the training effectiveness of the device in various configurations. The present study was concerned with:

- assessing the contribution of motion simulation to the training of helicopter fleet replacement pilots;
- assessing the engineering fidelity of the motion platform concurrent with the study to insure that it was performing to design specifications; and
- identifying variables that are predictive of training success in fleet replacement training environment.

METHOD

A two-group transfer of training design was used to compare the flight performance of pilots trained with motion simulation to that of pilots trained on the device without motion. Pilots, who were randomly assigned to motion and no motion groups, were recent graduates of Navy Undergraduate Pilot Training (UPT). Two measures of trainee performance were used. The first was the number of first-pilot hours required to achieve proficiency as demonstrated on a check flight in the SH-3 helicopter. The second measure was the number of training trials required to demonstrate proficiency on selected flight tasks in the SH-3. Those measures were taken as indicative of success due to prior training in the simulator.

In addition to the motion/no motion conditions, variables that could be predictive of performance in the aircraft were identified. They were Student Ability (UPT Standard Flight Score and/or Radio Instrument Score), Aircraft Instructor Index (grading leniency), Aircraft Instructor Variability, Average Scheduling Time Between Flights, Scheduling Variability, Simulator Training Time, Simulator Training Trials, and Proficiency in the Simulator. Regression analyses were used to determine the relative contribution of the variables to training success.

RESULTS

No significant differences were found in performance between the group trained with motion from that of the group trained without motion. However, the study did identify a number of variables predictive of training success in the aircraft. These are:

- the number of training trials required to achieve proficiency in the simulator is correlated to the number of training trials required to attain proficiency in the aircraft (e.g., students slow to learn in the simulator are slow to learn in the aircraft)
- variability in instructors (grading leniency) is highly correlated with flight hours and task trials required for the student
- variability in flight scheduling is correlated to student success (i.e., students not receiving regularly scheduled training tend to progress more slowly)
- UPT grades are correlated with later success at the fleet readiness squadron (FRS).

SECTION I

INTRODUCTION

The impetus for incorporating motion simulation into flight simulators has been the belief that motion increases the "realism" and, consequently, the training effectiveness of the devices. The training effectiveness of expensive motion platforms has become an issue of interest. Transfer of training studies examining the role of motion have generally yielded negative answers to the question "Is motion needed for training?" (Jacobs and Roscoe, 1975; Woodruff, Smith, Fuller and Weyer, 1976; Gray and Fuller, 1977; Martin and Waag, 1978a; Martin and Waag, 1978b; Pohlmann and Reed, 1978; Ryan, Scott and Browning, 1978; Koonce, 1979). Despite the results of these studies, many pilots, particularly helicopter pilots, are firm in the conviction that motion is a major factor in simulator training. On balance, these disparate views require further resolution of the motion issue. One argument against the transfer studies is that they may be suspect on the grounds of experimental design. The problems of conducting experiments in the field have been well documented (see, for example, Campbell and Stanley, 1966; Cook and Campbell, 1979). Other transfer studies may be suspect from the grossness of airborne criteria data. For example, Caro, Shelnutt, and Spears (1981) discuss major considerations in selecting airborne criterion measures for transfer of training studies.

The present study is a contribution to the resolution of the role of motion simulation in helicopter pilot training. Several unique features of this assessment are of interest from the vantage point of experimental design and airborne criterion measures. These features provide assurance of a rigorous evaluation.

First, the sample of fleet replacement pilots undergoing transition training during the assessment period was sufficient to allow random assignment of students to a motion or no motion simulator training condition.

Second, the simulator and flight syllabus had been developed in a prior assessment of Device 2F64C with motion simulation. Scenarios or detailed scripts for each simulator training session had been written and tested. This provided a high degree of standardization for simulator training.

Third, an engineering assessment of the motion system insured motion cues were similar to the operational aircraft and the motion system faithfully reproduced these cues within design tolerances (see appendix A).

Fourth, the Computer Aided Training Evaluation and Scheduling (CATES) system mathematical decision model was employed to determine flight task proficiency (Rankin and McDaniel, 1980). This decision model has been demonstrated to be considerably more reliable than individual instructor judgments of student task proficiency (McDaniel, Pereyra, Rankin, and Scott, 1982). This model was envisaged to provide a more reliable and sensitive airborne criterion measure than previously used.

Fifth, data were collected on a number of variables that could induce variability into the airborne criterion measures. These data were used to identify major sources of variability in the airborne criterion measures and through "partitioning" techniques determined the contribution of simulator motion to training in the aircraft (Pedhazur, 1982).

Finally, certain accommodations were made in the design and conduct of the study due to the constraints associated with gathering data during the normal pilot production operations of the squadron. Simulator availability, instructor inexperience, and the rotation and biases associated with utilizing many instructors evaluating student performance, posed many problems. These, however, were anticipated and minimized by having TAEG personnel on board to monitor and assist in the data collection, provide detailed briefings and information to the instructor pilots, and standardize scoring procedures employed. Team members also rode in the simulator to monitor student training periods. All told, this "in situ" approach contributed to the assurance of a highly relevant evaluation within a tolerable range of experimental control.

ORGANIZATION OF THE REPORT

In addition to this introduction three sections and five appendices are included in this report. Section II describes the design and logic of the study. The subjects, training devices and procedures used in conducting the experiment are described. Section III presents the results of the data analyses. Section IV provides a discussion of the results and the correspondence or differences with results from previous studies. Limitations of this study are noted and implications of the results are presented. In addition, section IV presents concise conclusions and recommendations developed from this experiment.

Appendix A contains the test and evaluation of Device 2F64C motion system. Appendix B contains a copy of one simulator scenario with accompanying grade sheet utilized in the training of both the control and experimental groups. Appendix C contains representative tasks and task characteristics selected for analysis. Appendices D and E present intercorrelation matrices and tests of significance for "A" and "B" stage tasks trials to proficiency.

SECTION II

METHOD

A transfer of training design was used to assess the training effectiveness of the motion simulation for Device 2F64C. Performance in the SH-3 aircraft for a group of students that received training in the device with motion simulation was compared with a group trained in the device without motion simulation.

Two performance measures were used as criteria in this evaluation. The first measure was the number of first-pilot flight hours in the SH-3 aircraft required by each student to reach the level of proficiency needed to successfully pass designated flight checks. The second measure was the number of training trials each student required to demonstrate proficiency for specific flight tasks. The CATES system mathematical decision model was employed to determine flight task proficiency (Rankin and McDaniel, 1980). This probabilistic model is based on the concept of examining graded trials in the sequence the trials are performed. When the task performance on a series of trials compares to that expected of a proficient pilot, the student is declared proficient for that specific task. The advantage of the CATES decision model appears to be the quantification of acceptable (proficient) performance, unacceptable (not proficient) performance, and the risks (alpha and beta) involved in making an inappropriate decision.

SUBJECTS

Twenty-six student pilots undergoing replacement pilot training at Helicopter Anti-Submarine Squadron 1 (HS-1) served as subjects in this experiment. These students received training as a member of one of four consecutive classes undergoing training from July 1982 to April 1983. All were recent graduates of Undergraduate Pilot Training (UPT) at Pensacola, Florida, and were designated Naval Aviators with instrument certification. The subjects represented a homogenous group in terms of previous flight experience and had no previous experience in the SH-3 aircraft. Subjects in each class were randomly assigned to receive training with or without motion simulation. Fourteen subjects received training with the simulator motion system disabled (No-Motion Group); twelve subjects received training with the simulator motion system enabled (Motion Group).

INSTRUCTORS

Training was administered by 33 HS-1 flight instructors as part of their regular duties. All instructors had completed at least 1 year in an operational assignment and had attended the Instructor Under Training Program at HS-1. Assignment of flight instructors for each student and for each flight was made on the basis of student, equipment and instructor availability.

AIRCRAFT AND TRAINING DEVICES

General descriptions are provided for the aircraft, flight simulator and cockpit procedures trainer (CPT).

AIRCRAFT. The Sikorsky SH-3 "Sea King" helicopter (figure 1) was used for training replacement pilots. The SH-3 is designed for a primary mission of antisubmarine warfare and a secondary mission of search and rescue. The replacement pilot receives flight instruction while occupying the first-pilot position (right seat). The instructor occupies the copilot position (left seat) and performs copilot and safety pilot duties in addition to providing flight instruction.

FLIGHT SIMULATOR. Simulator training for the replacement pilots was conducted in Device 2F64C (figure 2). The flight section provides training for most tasks associated with transition to the SH-3 and the maintenance of piloting skills. The cockpit area is a high fidelity replication of the SH-3 (figure 3). Training is normally administered to two students in the cockpit area. The replacement pilot receiving first-pilot training occupies the right position. The second replacement pilot is positioned in the left seat and serves as copilot. The instructor is positioned at the on-cab instructor station of the flight section. The instructor station is equipped with controls for establishing environmental conditions, problem parameters, malfunction insertion, problem or parameter freeze and record/playback. The flight simulator did not have a visual simulation system installed during the experiment.

Motion System. Device 2F64C is equipped with a six degrees of freedom synergistic motion platform for providing motion cues. Two conditions must be met for the motion system to function. First, the entrance ramp providing access to the flight section must be fully raised. Second, the motion system must be turned on at the instructor station. The motion system was disabled by only partially raising the entrance ramp. This approach was used to preclude interruptions by walk-on personnel while preventing the instructor from inadvertently starting the motion system from the instructor station.

Engineering Assessment of Motion Platform. Engineering tests were conducted to determine if the motion system performed "as advertised." Accelerations and response times were measured.

Inputs of known frequency, amplitude and duration were inserted into Device 2F64C and motion system response was recorded. A detailed description of the testing and results of the assessment are included in appendix A.

COCKPIT PROCEDURES TRAINER. Cockpit procedures training for both groups was conducted in Device 2C44. This trailerized device includes a facsimile of the SH-3 cockpit, an instructor console, and a digital computer. It provides training in powerplant management, systems tests, and normal and emergency procedures. Flight is simulated by setting in fixed altitude and airspeed parameters.

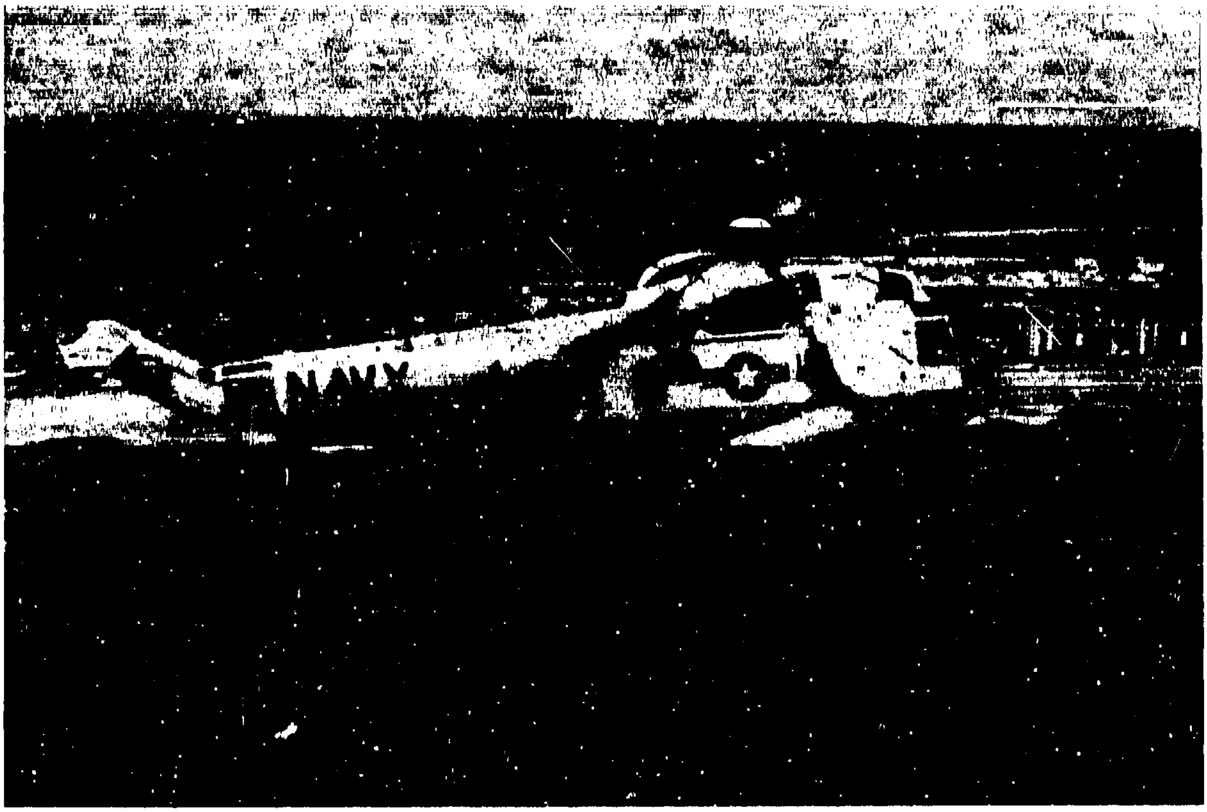

Figure 1. SH-3H Helicopter

Figure 2. Device 2F64C

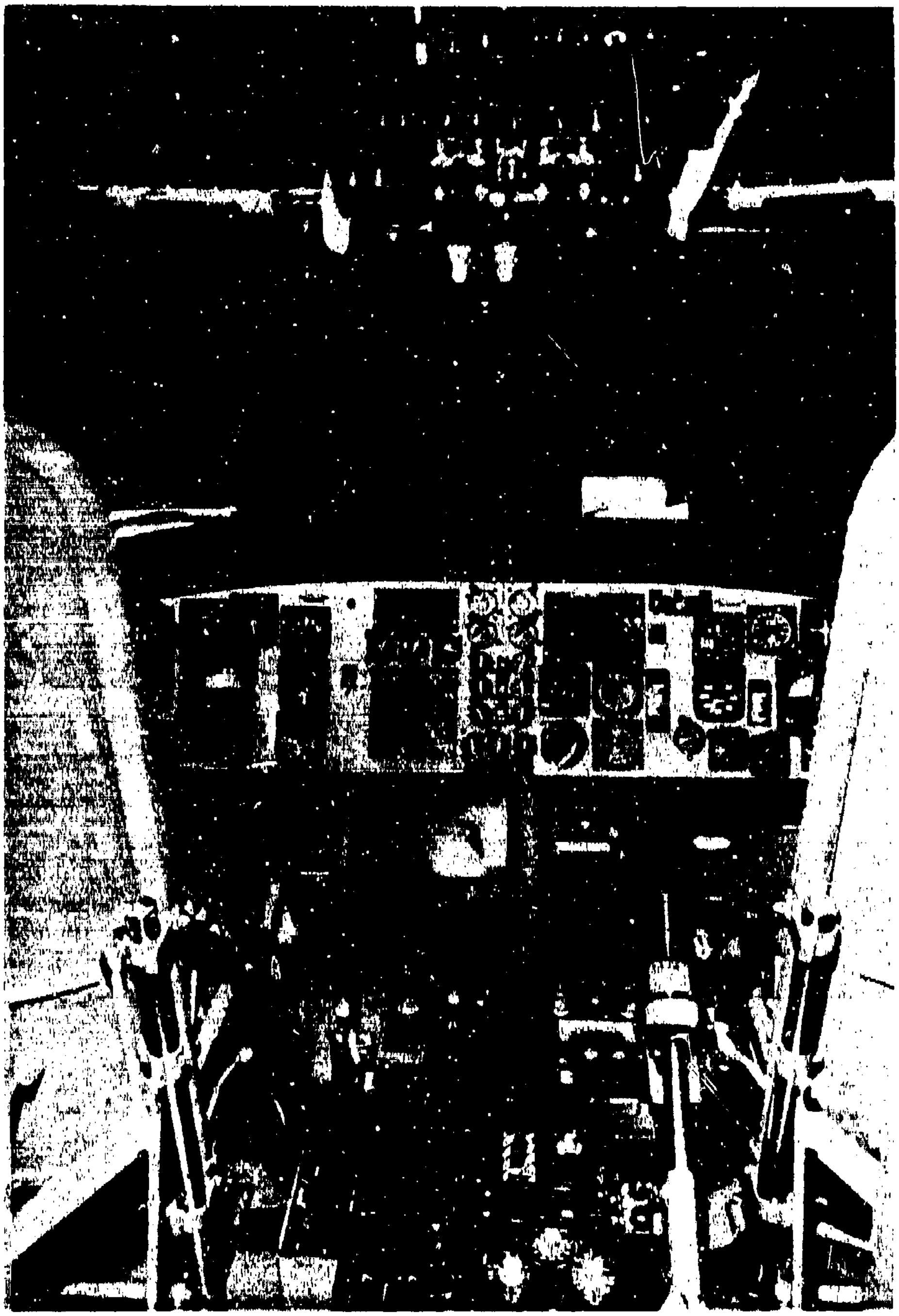

Figure 3. Cockpit of Device 2F64C

COURSE OF INSTRUCTION

The operational syllabus, developed from an earlier assessment of Device 2F64C, was used for both groups of students (Browning, McDaniel, Scott and Smode, 1982). The sequence of training and the associated hours are shown in table 1.

TABLE 1. OPERATIONAL SYLLABI SEQUENCE AND NUMBER OF TRAINING FLIGHTS

Training Medium Sequence	Flights	Time (Hours)
	A Stage	
Cockpit Procedures Trainer	7/P*	14.0
Flight Simulator	6/P*	12.0
Aircraft	5/P*	12.5
	B Stage	
Flight Simulator	6/P*	12.0
Aircraft	5/P*	12.5

*P = Proficiency. Training in each medium continued until proficiency was demonstrated.

The operational syllabus is divided into the squadron's two major stages of training: "A" stage and "B" stage. "A" stage is primarily concerned with transition training, aircraft operation and emergency procedures for the SH-3 under visual flight rules. "B" stage focuses on mission oriented training necessary to conduct antisubmarine warfare and search and rescue function in the SH-3 aircraft. This training is generally conducted under instrument flight rules.

INSTRUCTION. Instruction for each flight in the CPT, flight simulator, and aircraft was sequenced by the appropriate Syllabus Grade Card. Additional control of flight simulator training was accomplished by using detailed scripts. All students received equivalent flight simulator training as specified by these scripts. A complete description and discussion of the development process for the scripts or scenarios are provided by Browning, McDaniel, Scott and Smode, 1982. A sample syllabus grade card and scenario are contained in appendix B.

STUDENT GRADES. Grades for each flight task were recorded on the syllabus grade card. Two grading systems were used to record student performance. HS-1 has traditionally employed the Naval Air Training and Operating Procedures Standardization (NATOPS) scoring system for grading tasks trained

in the CPT, flight simulator, and the aircraft. This system provides criteria for evaluating performance at three levels. The second system was a proficiency based grading method developed to increase the precision of grading during the assessment of Device 2F64C. The system uses a dichotomous scale to score each practice trial for each task. A practice trial performed to NATOPS standard was scored as "P"; a practice trial not meeting NATOPS criteria was scored a "1." Trials were graded in the sequence performed. Complete protocols of task trial performance were derived by sequentially combining trial data for specific tasks across all appropriate syllabus grade cards.

PROCEDURE

During orientation for each class, students were briefed concerning the purpose of the experiment and the procedures to be followed. Written instructions were provided to each of the students and flight instructors.

Students proceeded through the CPT portion of the operational syllabus. Upon completion of the CPT syllabus, students were randomly assigned to simulator training with motion or with no motion. All simulator sorties were conducted with two students scheduled per 4-hour session. Each student alternately received first-pilot training and copilot training of approximately 1 hour and 45 minutes per position. After a break, the students switched positions and completed the simulator session. Students alternated the order of first-pilot training in successive flight simulator sessions to preclude order effects. To prevent confounding of the motion variable, students within each group were paired during flight simulator training. Thus, students assigned to the Motion Group received all flight simulator training with the motion system functional; students in the No-Motion Group received all training with the simulator motion system disabled. TAEG personnel observed both "A" stage and "B" stage flight simulator sessions to insure that the motion system was in the appropriate state and that instructors followed the scenarios for all students.

After flight simulator training, the student proceeded to the aircraft. Students continued aircraft training until they had successfully completed the aircraft check flight. Once aircraft training had begun, students were not permitted to return to the flight simulator until the successful completion of the appropriate stage check flight.

Instructors recorded student performance data for the training flight on the syllabus grade card. From copies of the syllabus grade cards, data were entered into the prototype CATES system at the TAEG, Orlando, Florida.

Copies of each student's Pilot Training Summary (ATJ), CNATRA Form 1542/95, and Naval Aviator Training Stage Grades--Helo, CNATRA Form 1542/5C, were collected. These records indicated the student's performance in Undergraduate Pilot Training.

DATA ANALYSIS

In addition to the motion/no-motion condition, several variables that could have an impact on student performance measures in the aircraft were quantified and used in the data analysis. The nomenclature and method used to quantify the variables for each student were:

- Student Ability (UPT Standard Flight Score). The standard flight score recorded in primary, intermediate and advanced phases of UPT training were summed.

- Student Ability (UPT Radio Instrument (RI) Flight Score). The raw flight score recorded for the Radio Instrument stage in UPT was used to indicate the student's ability to perform instrument flight.

- Aircraft Instructor Index (measure of instructor leniency in grading). Each instructor's grading norm was determined by the proportion of trials graded "P" (performed to standard) to the total number of trials graded. The Aircraft Instructor Index was the mean proportion for all flight instructors providing training to the student until proficiency was achieved.

- Aircraft Instructor Variability. The standard deviation of the Aircraft Instructor Index was used as a measure of instructor variability.

- Average Scheduling Time. The mean number of days between each aircraft training flight and specific flight tasks was determined.

- Scheduling Variability. Irregularity in scheduling was obtained by using the standard deviation of the Average Scheduling Time.

- Simulator Training Hours. The total amount of first- pilot training hours each student received in the flight simulator for each stage was determined.

- Simulator Training Trials. The total number of simulator practice trials for a specific task was determined.

- Simulator Proficiency. The proportion of trials graded "P" to the total number of training trials performed in the flight simulator was calculated. Simulator Proficiency was determined for each flight task.

First-pilot flight hours required to achieve "A" and "B" stage proficiency were determined for each student. The number of trials required to demonstrate flight task proficiency was determined by the CATES system mathematical decision model. One hundred and seventy-four flight tasks were trained throughout the course of instruction. Many of these tasks were highly specific procedural tasks trained only in the CPT and flight

simulator; others related only to ground operations. The data analysis of trials to proficiency for specific flight tasks was reduced to an examination of a representative sample of "A" and "B" stage flight tasks.

FLIGHT TASK SAMPLE. The representative sample of flight tasks was selected from tasks performed on the "A" and "B" stage check flights. The tasks selected were airborne maneuvers that would use the full range of motion cues. Tasks were selected that comprised a range of difficulty from "easy to perform" to "difficult to perform." The tasks ranged from normal operational tasks to operating the aircraft with degraded systems and covered both transition and mission-oriented tasks. Nine tasks were selected for analysis; five were from "A" stage and four were from "B" stage. The tasks and task characteristics are described in appendix C.

MULTIPLE REGRESSION ANALYSIS. Flight hours and trials required to achieve proficiency were analyzed using linear multiple regression techniques. Initially, all variables were entered into the regression analysis. The variable least predicting flight hours or trials to proficiency was deleted. Consistent with backward elimination techniques, the process of deleting one variable at a time was continued until each of the remaining variables was contributing to the predicted overall variance beyond the .05 confidence level. However, if the motion/no motion condition had been eliminated prior to selection of this "best set" of predictors, this condition was forced into the model as a final step.

COMMONALITY ANALYSIS. The completed regression analysis resulted in identification of major sources of variance for flight hours and trials to proficiency for the selected tasks. Commonality analysis was used as a method of variance partitioning designed to identify proportions of variance that may be attributed uniquely to each of the variance sources (Pedhazur, 1982). The unique contribution of a variable is defined as the variance attributed to that variable when it is entered last in the regression equation. The common contribution of the independent variable is determined by subtracting each of the unique contributions from the overall explained variance. The unique contribution for each independent variable provides a relative comparison among the variables concerning the potency for predicting variance in the dependent or criterion variable. Unique contributions were determined for each source of variance identified in the regression analysis.

SECTION III

RESULTS

This section presents the analyses of student performance. Due to the diversity of tasks and natural breaks in the flight syllabus, the results are reported in major subsections consistent with "A" stage and "B" stage training.

"A" STAGE FLIGHT HOURS

Table 2 presents the mean, standard deviation and range of flight hours required by each group to complete "A" stage aircraft training.

TABLE 2. AVERAGE "A" STAGE FLIGHT HOURS FOR THE MOTION AND NO-MOTION GROUPS

Group	Average Flight Hours	Standard Deviation	Range
Motion (N=12)	14.1	2.3	11.3-18.3
No Motion (N=14)	13.2	2.5	9.6-20.0

As evidenced by the descriptive data, small directional differences existed between the two treatment groups. However, as indicated by the ranges and standard deviations, individual differences within the groups appeared relatively large. Reliable differences were determined in subsequent data analyses.

Table 3 presents the intercorrelation matrix of the initial set of variables used in the regression analysis. The correlation between flight hours and the motion condition failed to reach the .05 level of significance. A significant correlation (r=-.493) was obtained for flight hours with Student Ability (UPT score). Low correlations between the variables selected for the regression analysis indicated the variables were independent and, therefore, desirable in the regression analysis. One exception was the intercorrelation between Scheduling Time and Scheduling Variability which indicates both measures are highly related and may measure similar dimensions.

Major sources of flight hour variability were identified by the final regression model. This model accounted for 42 percent of the total variance in flight hours (R^2 = .422). This was significant beyond the .05 level ($F_{3,22}$ = 5.35; MS error = 3.718).

The unstandardized regression coefficient, significance test and unique contribution of each variable are shown in table 4.

TABLE 3. INTERCORRELATION MATRIX FOR "A" STAGE FLIGHT HOURS (N=26)

	Flight Hours	Student Ability (UPT Score)	Simulator Hours	Instructor Index	Instructor Variability	Scheduling Time	Scheduling Variability	Motion
Flight Hours	1.000	-.493*	.109	-.371	.014	-.064	-.013	-.193
Student Ability (UPT Score)	-.493*	1.000	.094	.007	-.236	-.167	-.186	-.050
Simulator Hours	.109	.094	1.000	.066	.302	.077	.132	.246
Instructor Index	-.371	.007	.066	1.000	.099	.264	.255	.039
Instructor Variability	.014	-.236	.302	.099	1.000	-.243	-.193	-.141
Scheduling Time	-.064	.167	.077	.264	-.243	1.000	.917*	.085
Scheduling Variability	-.013	.186	.132	.255	-.193	.917*	1.000	.014
Motion	-.193	.060	.246	.039	-.141	.085	.014	1.000

*$p < .05$

TABLE 4. REGRESSION COEFFICIENTS, UNIQUE CONTRIBUTIONS, AND SIGNIFICANCE TEST FOR VARIABLES PREDICTING "A" STAGE FLIGHT HOURS

Variable	Regression Coefficient	Unique Contribution (Percent)	t-Value
Student Ability (UPT Standard Flight Score)	-.106	25%	-3.098*
Aircraft Instructor Index	-25.907	13%	-2.214*
Motion/No Motion	-.977	4%	-1.285
Constant (Intercept)	49.173	--	--

$^*p < .05$

The variable of interest, motion/no motion, failed to reach significance at the .05 level. Commonality analysis revealed the unique contribution of the motion condition was only four percent of the total variance in flight hours. Both student ability and instructor differences show a reliable association with the number of flight hours required to complete "A" stage training. Student ability contributed 25 percent to the total variance in flight hours. As indicated by the negative correlation and regression coefficient, students with higher UPT flight scores required less flight time to complete training. The analysis further revealed students receiving "A" stage flight instruction with less conservative instructors progressed through flight training with considerably fewer flight hours than students assigned more conservative instructors.

"A" STAGE FLIGHT TASKS

Table 5 presents the means and standard deviations of aircraft trials needed to achieve proficiency for the Motion and No-Motion groups.

TABLE 5. GROUP MEANS AND STANDARD DEVIATIONS OF AIRCRAFT TRIALS TO PROFICIENCY FOR "A" STAGE TASKS

Task	Motion (N=12)		No Motion (N=14)	
	Mean Trials	Standard Deviation	Mean Trials	Standard Deviation
Normal Approach	10.3	11.5	10.1	7.3
Normal Takeoff	4.6	1.9	5.0	1.6
Normal Landing	7.0	3.8	4.4	2.0
Running Takeoff	4.5	2.1	3.3	1.5
ASE Off Takeoff	7.3	3.9	8.1	3.8

The descriptive data reveal only small differences between groups with the exception of the Normal Landing Task. Regression analysis and significance testing were performed to determine reliable differences attributable to the motion condition for each task. Intercorrelation matrices, regression analysis summary tables, unstandardized regression coefficients and significance tests are shown in appendix D.

The Pearson Product correlations (zero-order correlations) for each of the variables in the analysis with the criterion variable, Trials to Proficiency, are shown in table 6. A significant correlation between motion and trials to proficiency was found for the Normal Landing task. The remaining tasks examined evidenced low correlations between Motion and Trials to Proficiency. Generally, high correlations are found across all tasks between trials to proficiency and Aircraft Instructor Index, Instructor Variability, Average Scheduling Time and Scheduling Variability. Student Ability was highly associated with trials to proficiency on three of the five flight tasks. Low, unreliable correlations between trials to proficiency and Simulator Training Trials and Simulator Proficiency were evidenced.

TABLE 6. CORRELATIONS OF VARIABLES WITH TRIALS TO PROFICIENCY FOR "A" STAGE FLIGHT TASKS

Variable	Task				
	Normal Approach	Normal Takeoff	Normal Landing	Running Takeoff	ASE Off Takeoff
Motion	-.010	.121	-.412	-.200	.100
Student Ability (UPT Score)	-.588	-.314	.065	-.060	-.617
Aircraft Instructor Index	-.396	-.303	-.432	-.454	-.213
Aircraft Instructor Variability	.344	.729	.486	.612	.482
Average Scheduling Time	.523	.505	.688	.258	-.092
Scheduling Variability	.664	.373	.406	.577	.155
Simulator Training Trials	.100	.115	-.230	-.014	-.176
Simulator Proficiency	.226	.382	-.159	-.082	-.084

Regression and commonality analyses were performed to determine the predictive power of the variables on trials to proficiency. The unique contributions provide a relative comparison of the predictive power for the variables; i.e., variables with larger unique contributions are the more powerful predictors. Table 7 presents the unique contribution of variables determined by commonality analysis.

TABLE 7. UNIQUE CONTRIBUTION OF VARIABLES FOR PREDICTING TRIALS TO PROFICIENCY (PERCENT)

Variable	Task				
	Normal Approach	Normal Takeoff	Normal Landing	Running Takeoff	ASE Off Takeoff
Motion	0.2	2.2	1.7	0.6	0.5
Student Ability (UPT Flight Score)	9.0*	6.6*	--	--	24.5*
Aircraft Instructor Index	--	12.7*	--	10.5*	--
Aircraft Instructor Variability	--	42.9*	--	28.2*	10.5*
Average Scheduling Time	--	--	30.1*	--	--
Scheduling Variability	19.0*	--	7.1	--	--
Simulator Training Trials	--	--	--	--	--
Simulator Proficiency Ratio	--	--	--	--	--
Joint Contribution of Variables	26.0	4.7	18.6	20.6	13.4
**Total Explained Variance	54.2	69.1	57.5	59.9	48.9

*$p < .05$

**$R^2 = U_i + U_j + \cdots + U_m + J$

Where: U_i = Proportion of variance in criterion that is unique to predictor U_i

J = Proportion of variance in criterion due to joint combination of all predictors.

Significance notations were derived from significance tests of the regression coefficients. No entry in table 7 indicates variables deleted from the regression analysis because they failed to provide a significant increment to the total explained variance. The motion condition did not show a significant effect on trials to proficiency for any of the tasks. The unique contributions for motion across all tasks were extremely small indicating a weak affect. Other variables uniquely contributed to variations in aircraft trials to proficiency with considerably more potency. Although there appeared to be a difference between groups for the Normal Landing task, subsequent analysis reveals this difference may be attributable to differential scheduling of the two groups rather than the motion condition.

"B" STAGE FLIGHT HOURS

Table 8 presents the mean, standard deviation and range of flight hours required by each group to complete "B" stage aircraft training.

TABLE 8. AVERAGE "B" STAGE FLIGHT HOURS FOR THE MOTION AND NO-MOTION GROUPS

Group	Average Flight Hours	Standard Deviation	Range
Motion (N=11)*	14.1	1.3	11.5-16.5
No Motion (N=14)	14.9	2.2	12.2-20.5

*One student was dropped from "B" stage data analysis due to administrative delay.

Similar to the findings in "A" stage, the difference in flight hours between the two groups was small and may be unreliable. Individual differences within the groups appear relatively large.

Table 9 presents the intercorrelation matrix of the initial set of variables used in the regression analysis.

TABLE 9. INTERCORRELATION MATRIX FOR "B" STAGE FLIGHT HOURS (N=25)

	Flight Hours	Student Ability (UPT)	Simulator Hours	Instructor Index	Instructor Variability	Scheduling Time	Scheduling Variability	Student Ability (RI score)	Motion
Flight Hours	1.000	-.396*	.198	-.464*	.315	-.070	-.263	-.519*	.326
Student Ability (UPT)	-.396*	1.000	-.210	.412*	-.370	-.041	.146	.593*	-.088
Simulator Hours	.198	-.210	1.000	-.273	.021	.084	.032	-.180	-.130
Instructor Index	-.464*	.412*	-.273	1.000	-.847*	.170	.214	.562*	-.074
Instructor Variability	.315	-.370	.021	-.847*	1.000	-.241	-.280	-.375	.139
Scheduling Time	-.070	-.041	.084	.170	-.241	1.000	.722*	.146	-.083
Scheduling Variability	-.263	.146	.032	.214	-.280	.722*	1.000	.163	.045
Student Ability (RI score)	.519*	.593*	-.180	.562*	-.375	.146	.163	1.000	-.124
Motion	.326	-.088	-.130	-.074	.139	-.083	.045	-.124	1.000

*$p < .05$

The correlation between flight hours and the motion condition failed to reach the .05 level of significance. However, high correlations were indicated for flight hours and both measures of student ability (UPT flight scores and RI scores). A significant correlation also existed between flight hours and Aircraft Instructor Index.

Major sources of variability were identified by the final regression model. This model accounted for 34 percent of the total variance in flight hours ($R^2 = .339$) and was significant beyond the .05 level ($F_{2,22} = 5.64$, MS error = 2.650). Table 10 presents the unstandardized regression coefficient, unique contribution, and significance test for each variable in the final regression model.

TABLE 10. REGRESSION COEFFICIENTS, UNIQUE CONTRIBUTIONS AND SIGNIFICANCE TEST FOR VARIABLES PREDICTING "B" STAGE FLIGHT HOURS

Variable	Regression Coefficient	Unique Contribution (Percent)	t-Value
Student Ability (Radio Instrument Score)	-42.149	28.3	-2.783*
Motion	1.005	6.9	1.521
Constant (Intercept)	141.153		

*$p < .05$

The motion condition failed to reach the .05 level of significance. Commonality analysis revealed the unique contribution of the motion condition was less than seven percent of the total variance in flight hours. Student ability, as evidenced by the UPT RI score, was the most reliable predictor of variance in flight hours. Students with above average UPT RI flight scores required fewer flight hours to demonstrate proficiency.

"B" STAGE FLIGHT TASKS

The means and standard deviations of aircraft trials needed to achieve proficiency for a selected sample of B stage tasks are shown in table 11.

TABLE 11. GROUP MEANS AND STANDARD DEVIATIONS OF AIRCRAFT TRIALS TO PROFICIENCY FOR "B" STAGE TASKS

Task	Motion (N=11)		No Motion (N=14)	
	Mean Trials	Standard Deviation	Mean Trials	Standard Deviation
Freestream Recovery	4.9	2.8	8.6	6.6
Alternate Approach	5.5	2.5	4.7	2.4
Coupled Hover Departure Procedures	3.5	1.4	6.0	3.6
SAR Search	3.8	1.1	3.7	1.3

The Motion group appeared to demonstrate an advantage for both the Freestream Recovery and Coupled Hover Departure Procedures flight tasks. Conversely, the No-Motion group required slightly fewer trials to achieve proficiency for the Alternate Approach and SAR Search flight tasks. Regression analysis and significance testing were employed to determine if these group differences were reliable. Intercorrelation matrices, regression analysis summary tables, unstandardized regression coefficients and significance tests are contained in appendix E.

Table 12 presents the zero-order correlation for each of the variables in the analysis with trials to proficiency across four "B" stage tasks.

TABLE 12. CORRELATIONS OF VARIABLES WITH TRIALS TO PROFICIENCY FOR "B" STAGE FLIGHT TASKS

Variable	Task			
	Freestream Recovery	Alternate Approach Pilot Procedures	Coupled Hover Departure Procedures	SAR Search
Motion	.342	-.154	.414	-.045
Student Ability (UPT Score)	-.378	-.470	-.262	-.351
Student Ability (RI Score)	-.536	-.482	-.412	-.282
Aircraft Instructor Index	-.606	-.126	-.348	-.338
Aircraft Instructor Variability	.370	.328	.433	.115
Average Scheduling Time	.180	.357	.299	.182
Scheduling Variability	.345	.293	.238	.173
Simulator Training Trials	-.452	.287	.249	-.134
Simulator Proficiency	-.032	-.031	-.029	-.125

A significant correlation between motion and trials to proficiency was found for Coupled Hover Departure Procedures. Higher correlations were evidenced for Student Ability (RI score) than Student Ability (UPT score). This would indicate the RI score in UPT provides a better indicator for "B" stage performance. The relationship of variables to trials to proficiency in "B" stage tasks was similar to those found in "A" stage tasks. However, comparison of "B" stage tasks (table 12) with "A" stage tasks (table 6) reveals generally lower correlations.

The power for predicting trials to proficiency for the variables was determined by regression and commonality analysis. Table 13 presents the unique contribution of the major variables identified in the regression analysis and results of significance tests for the variables. Commonality analysis was not performed for the SAR search task. Regression analysis failed to yield a "best set" of predictor variables for this task. This failure was likely attributable to the small variance in trials to proficiency for this particular task. A reliable difference between the motion and no-motion groups was found for one task, Coupled Hover Departure Procedures. Similar to "A" stage results, other variables uniquely contributed to variations in aircraft trials to proficiency with greater potency.

TABLE 13. UNIQUE CONTRIBUTION OF VARIABLES FOR PREDICTING TRIALS TO PROFICIENCY (PERCENT)

Variable	Task			
	Freestream Recovery	Alternate Approach	Coupled Hover Departure Procedures	SAR Search
Motion	8.4	2.4	13.9*	**
Student Ability (UPT Flight Score)	--	--	--	**
Student Ability (UPT RI Flight Grade)	--	23.2*	--	**
Aircraft Instructor Index	33.4*	--	--	**
Aircraft Instructor Variability	--	--	11.0	**
Average Scheduling Time	--	--	7.4	**
Scheduling Variability	--	6.6	--	**
Simulator Training Trials	--	--	13.3*	**
Simulator Proficiency Ratio	--	--	--	**
Simulator Contribution of Variables	3.4	9.2	3.0	**
**Total Explained Variance	45.2	43.4	48.6	40

*$p < .05$
**Commonality Analysis not performed.

SECTION IV

DISCUSSION AND RECOMMENDATIONS

A reliable difference in student performance in the aircraft attributable to previous motion or no-motion based training in Device 2F64C was found for only one task. Differences in "A" stage and "B" stage flight hours and trials to proficiency for eight flight tasks failed to reach significance. These results are consistent with the findings of similar studies that have failed to detect significant transfer of training effects of platform motion. The directional contribution of motion versus no motion was also mixed; i.e., "A" stage flight hours favored the no-motion condition, "B" stage hours favored the motion-trained group. Since these differences were not significant, no clear trends were evident across the representative sample of tasks.

The results of this study, utilizing sophisticated analyses, did not demonstrate a contribution due to motion. However, two important features must be regarded as contributors to the results: (1) the use of performance ratings as criteria and (2) the uncontrolled variance typical of field settings. Concerning airborne criterion measures, both flight hours and trials to proficiency for specific tasks were marginally sensitive to variance sources within the training environment. Trials to proficiency appeared to be the better measure from the aspect of "explaining" or "predicting" greater amounts of variance. Variations in both measures were in the proper direction. Students displaying better performance in previous training (UPT) tended to exhibit better performance in the FRS. Delays and irregularities in scheduling also resulted in more training time and task practice to achieve proficiency. The greater the variability in instructor grading, the more flight hours and practice trials the student required to demonstrate proficiency. Conservative instructors, typified by a low Aircraft Instructor Index, required more observations (flight hours and training trials) to conclude that the student was proficient. From these indications it appears the airborne criteria were influenced by instructor leniency rating biases.

Instituting greater precision in controlling the major sources of variance identified in this study poses a problem for transfer effectiveness evaluations. Vagaries in scheduling, instructor differences and instructor assignment and student abilities are "facts of life" in operational units. The required control of these variables may not be practical or possible.

The absence of transfer of training does not necessarily indicate a lack of value for a motion system. Rather, the results can be viewed from the vantage point that other sources of variance within the training environment contribute to, or detract from, the overall training effectiveness more than does the motion feature. This awareness suggests that the achievement of training effectiveness and efficiency is influenced more by good training management than by the addition of the motion platform to the simulator.

RECOMMENDATIONS

Conclusions and recommendations follow.

CONCLUSION	RECOMMENDATION
Platform motion training in the simulator did not transfer to the aircraft.	If motion system becomes inoperative, continue to train using the syllabus and scenarios developed for Device 2F64C.
An engineering assessment demonstrated that the motion platform was within design specifications.	The formal assessment of a device should include an engineering evaluation of major device components (i.e., motion system, visual system).
The number of training trials or hours required to master tasks in the aircraft can be accurately predicted using regression analysis. The best predictors are simulator training trials, Aircraft Instructor Index, Scheduling Variability and Student Ability.	Training management should use the information concerning the predictors to structure and manage the training program to achieve greater effectiveness and efficiency.
Low reliability in instructor ratings of student performance was evidenced.	Institute more well-defined performance standards for flight tasks in the present flight instructor training program at the FRS.
Student performance, as determined by instructor ratings, is affected by perturbations in the training schedule.	Control special qualifications training and other student requirements to preclude interferences with flight training.
Students exhibiting lower than average performance in UPT are more apt to encounter difficulties due to scheduling delays, scheduling variability and instructor variability.	Insure training is regularly scheduled for student with below average UPT and RI flight scores. These students should receive priority in the allocation of available training resources.

POST NOTE

This study suggests strongly the need for improved management of FRS training systems and increased control of relevant variables (e.g., standardization of instruction, instructor training, scheduling).

The study also demonstrates a need for improved methods (e.g., sensitivity analysis) to assist in identifying significant extraneous variables prior to conducting a transfer of training study. This would permit the institution of vigorous controls to reduce the effects of these variables and reduce the probability of them masking potential treatment effects. The observation by Browning, McDaniel, Scott and Smode (1982) is appropriate:

> The organization of Fleet Readiness Squadrons should be examined to determine if these units are optimally structured to meet today's high technology training requirements. Management of training and instructing in today's training environment demands that training managers and instructional personnel be appropriately trained and provided stable assignments to ensure effective use of their skills.

In addition to assessing the structure of the FRS, training program evaluation should be included as an inherent part of the FRSs' mission and function statement. A formal ongoing training program evaluation would provide a continual audit of the training program and would provide the mechanism for incorporating more effective training strategies as appropriate.

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APPENDIX A

TEST AND EVALUATION OF DEVICE 2F64C MOTION SYSTEM

N-732:SB/BB
1 Mar 83

MEMORANDUM

From: Naval Training Equipment Center, Code N-732
To: Training Analysis and Evaluation Group
Via: (1) N-73
(2) N-7

Subj: Device 2F64C Motion System; test and evaluation of

Encl: (1) Test and Evaluation of Device 2F64C Motion System

1. Naval Training Equipment Center, Visual Technology Research Simulator Branch personnel conducted motion system tests on Device 2F64C at NAS Jacksonville on 27-29 December 1982. This was done in response to the Training Analysis and Evaluation Group's request to obtain equipment performance data prior to the Training Effectiveness Evaluation of Device 2F64C, SH-3 WST. The testing method used was similar to methods developed to test VTRS and provided an opportunity to apply these methods outside the research environment. The test results are reported in enclosure (1).

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TEST AND EVALUATION OF DEVICE 2F64C MOTION SYSTEM

1. INTRODUCTION

When motion system performance is evaluated, the normal procedure is to perform isolated subsystem tests. This usual testing procedure does not, however, relate subsystem performance to the total system behavior. Figure 1 shows the basic subsystems which make up a total motion system chain. The test objective here was to measure acceleration at the pilot station as induced by control stick commanded inputs.

2. TEST METHOD

The test procedure used consisted of introducing control stick step commands and measuring the resulting motion cues at the pilots station. This test procedure measured total end-to-end system hardware and software behavior.

The control stick input was provided by a square wave generator, introduced at the point where the stick analog inputs are fed into the host computer A/D.

Aerodynamic accelerations were then set to prescribed magnitudes one axis at a time whenever control stick polarity changed. This instantaneous setting of aerodynamic acceleration upon acknowledgement of control stick change of state results in removing all aerodynamic lags. When any one axis was excited, accelerations along the remaining axes were set to zero. Removing the aerodynamics in this manner in no way altered the normal computational time.

The motion system drive software was not modified for this test.

Accelerometers were supplied and calibrated for this test by the Naval Air Test Center. The accelerometers were mounted rigidly directly behind the pilots seat. The X (longitudinal) and Y (lateral) accelerometers both had a ± 1 G dynamic range while the Z (vertical) accelerometer had a ± 3 G dynamic range. Tables 4 and 5 show the calibration data for the 1 G and 3 G accelerometers.

A Brush strip recorder was used to record the 3 accelerometer output signals and the drive signal from the signal generator. In addition to the strip recording, all of the test runs were critically observed to complement the recorded results.

Each axis was individually excited with control stick inputs ranging in magnitude from 10 ft/sec^2 to 60 ft/sec^2. The period of the control stick input was purposely made long to assure sufficient time to reach steady-state, typically 6-8 seconds.

3. PERFORMANCE DISCUSSION

Figure 2 shows the typical input response signals from the tests and illustrates the important parameters and features. The typical acceleration response is composed of a positive onset pulse followed by a negative or deceleration washout pulse. Also, a steady state or sustained acceleration may be observed to follow the washout pulse. This is accomplished by a constant tilt of the platform.

The following describes the significant measures of motion system performance:

a. throughput delay - time between step command and first motion.

b. threshold acceleration - minimum magnitude of acceleration detectable by the pilot.

c. peak onset magnitude

d. onset pulse width

e. washout pulse width

f. time to onset peak - time from start of pulse to peak of pulse.

Figure 3 presents onset and washout peak accelerations as a function of command input aircraft acceleration. Observe that the Z axis onset response depends on whether the command is "up" or "down", thus two plots are presented. Generally, the family of onset responses are grouped together and are approximately linear. The slope of this family shows that the response acceleration is approximately 25% of the command acceleration. Similarly, the washout peak accelerations are linear. However, the magnitude of the washout is below threshold (0.08G's) for step commands below 2 G's and is only about 15% of the onset response.

Figure 4 presents the onset pulse duration at the threshold level of acceleration versus aircraft acceleration. Again, two curves are plotted for the Z axis, one for "up" motion and the other for "down" motion. If a criteria for minimum pulse duration is assumed, one can determine the resulting minimum acceleration that can be "sensed by the pilot". The pulse duration is observed to drop off sharply below about 0.5 G where it is about 100 milliseconds wide. The pulse duration increases to 300 milliseconds for aircraft accelerations at about 2 G's.

Throughput delay, as tabulated in Tables 1, 2, and 3, varies from a minimum of 80 milliseconds to a maximum of 160 milliseconds. This variation in throughput delay is due to the fact that the input command from the signal generator is not synchronized with the computers interface (A/D Sampler).

Figures 5 and 6 present typical strip chart accelerometer responses in the X axis and Y axis respectively. Note that the curves are similar with the exception that the Y axis shows a sustained acceleration component. This sustained acceleration in the Y axis was generated by a roll of the platform. Several secondary pulses of lesser amplitude than the main cueing pulse occurred several seconds after the main pulse. In several runs, the magnitude of these secondary pulses was about 50% of the main pulse (some higher). These secondary pulses, always of the same polarity as the onset pulse, are of sufficient magnitude to provide additional cueing not consistent with the command input.

Other performance data is presented in Tables 1, 2, and 3.

4. CONCLUSIONS

a. Throughput Delay - T.D., which varied from 80 msec to 160 msec, appears to be consistent with most trainer standards.

b. Onset Pulse Character - Pulse duration and magnitude are generally acceptable. However below 0.3G command, response is below the threshold of 0.08 G's. Also, the pulse duration drops below 200 milliseconds for commands below 1.5 G's.

c. Washout Character - Washout is generally below threshold for commands below 2 G's. This implies negative cueing for acceleration commands above 2 G's.

d. Secondary Cueing Pulses - These pulses are not desirable.

5. RECOMMENDATIONS

a. Throughput Delay - The possibility of reducing TD should be investigated. This data implies that the control input interface cycle time is different from the basic host 16 Hz computation rate.

b. Onset Pulse Character - Onset pulse duration at low command levels should be increased.

c. Secondary Cueing Pulses - These false cueing pulses should be eliminated.

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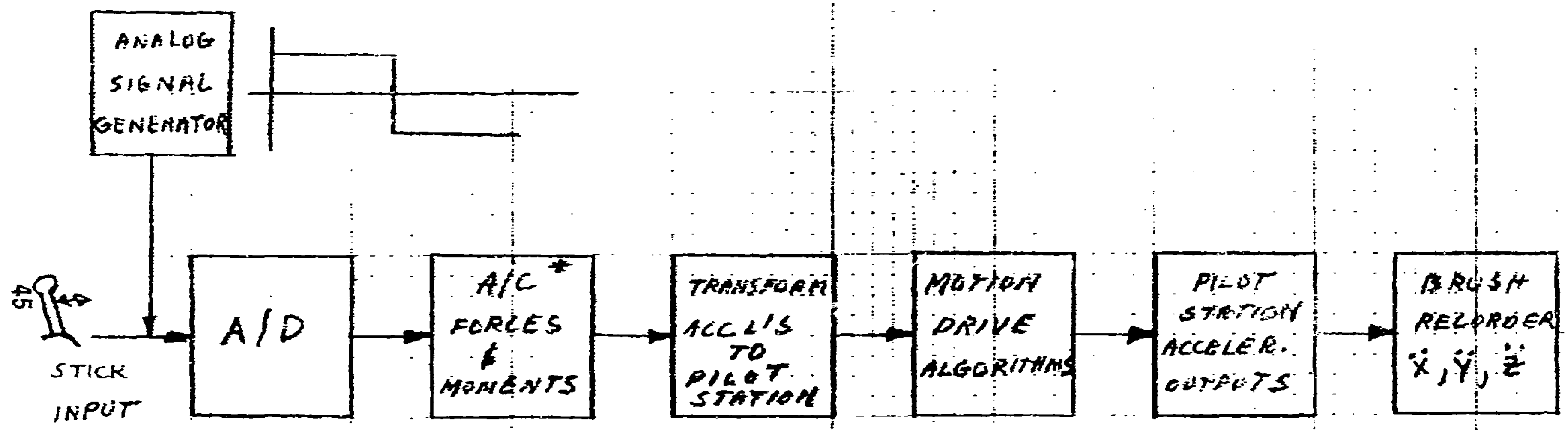

*MODIFIED TO BYPASS
AERO (NO LAG)
COMPUTATION THRUPUT
UNCHANGED

FIGURE 1

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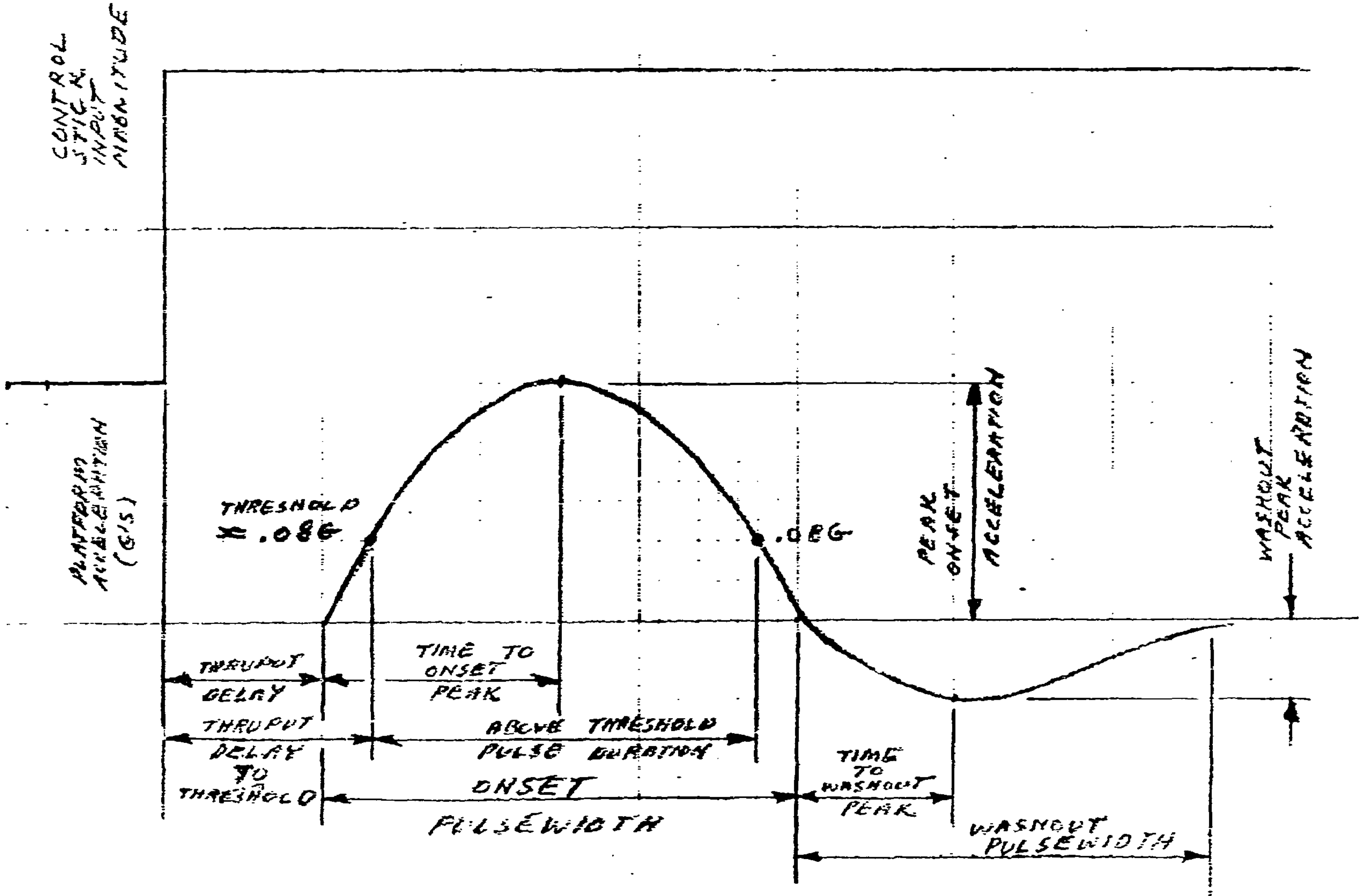

FIGURE 2

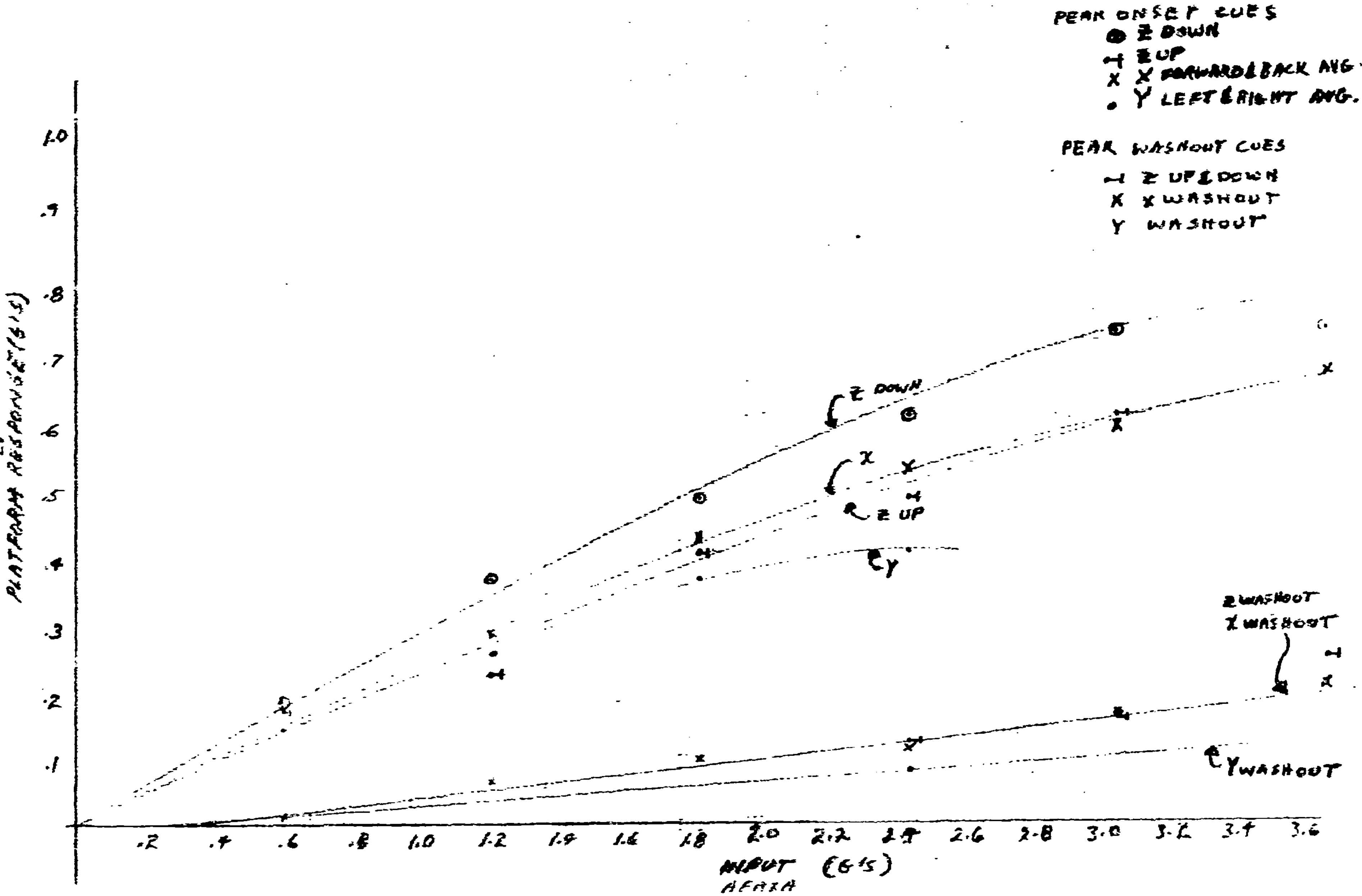

FIGURE 3

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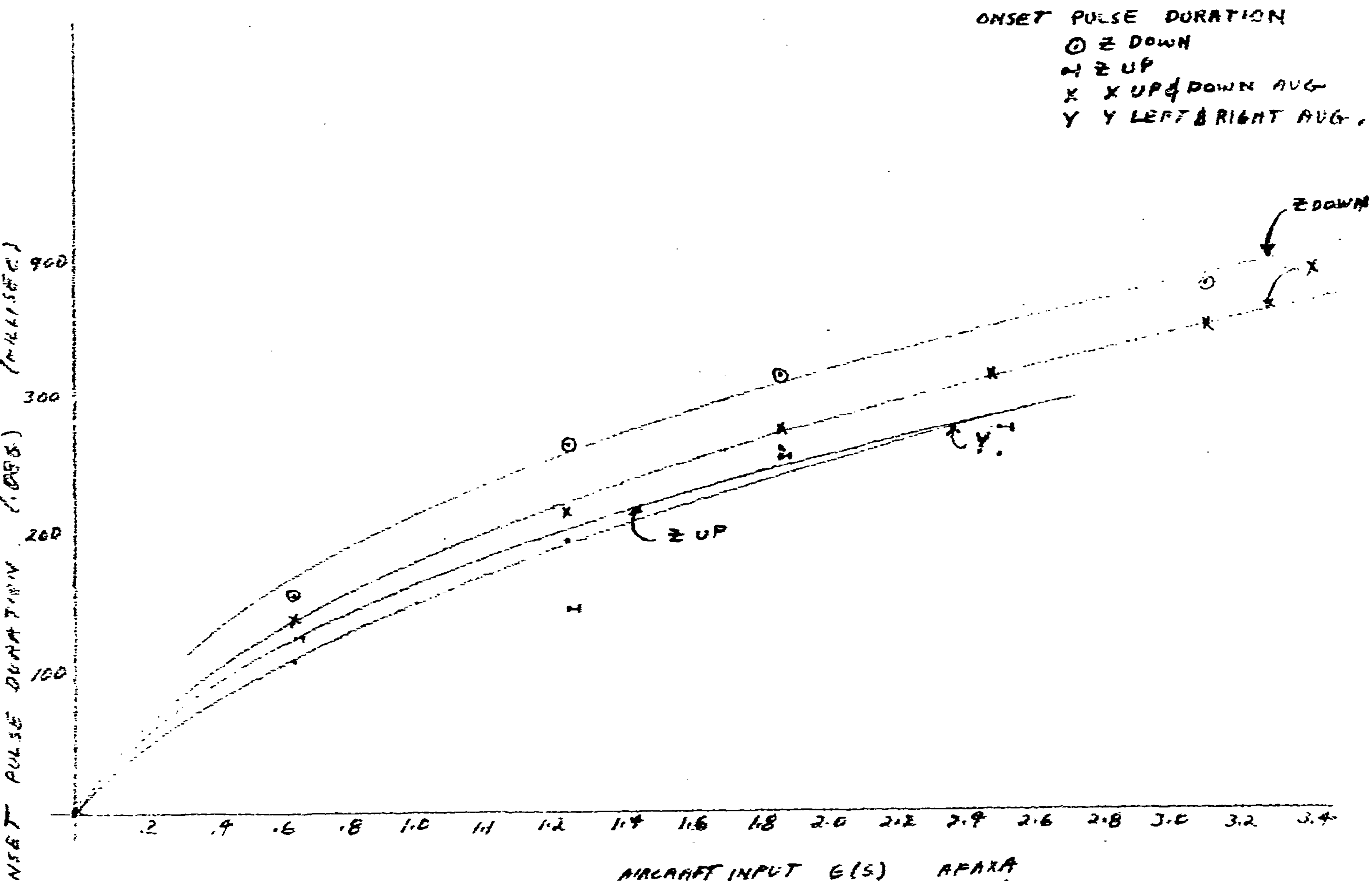

FIGURE 4

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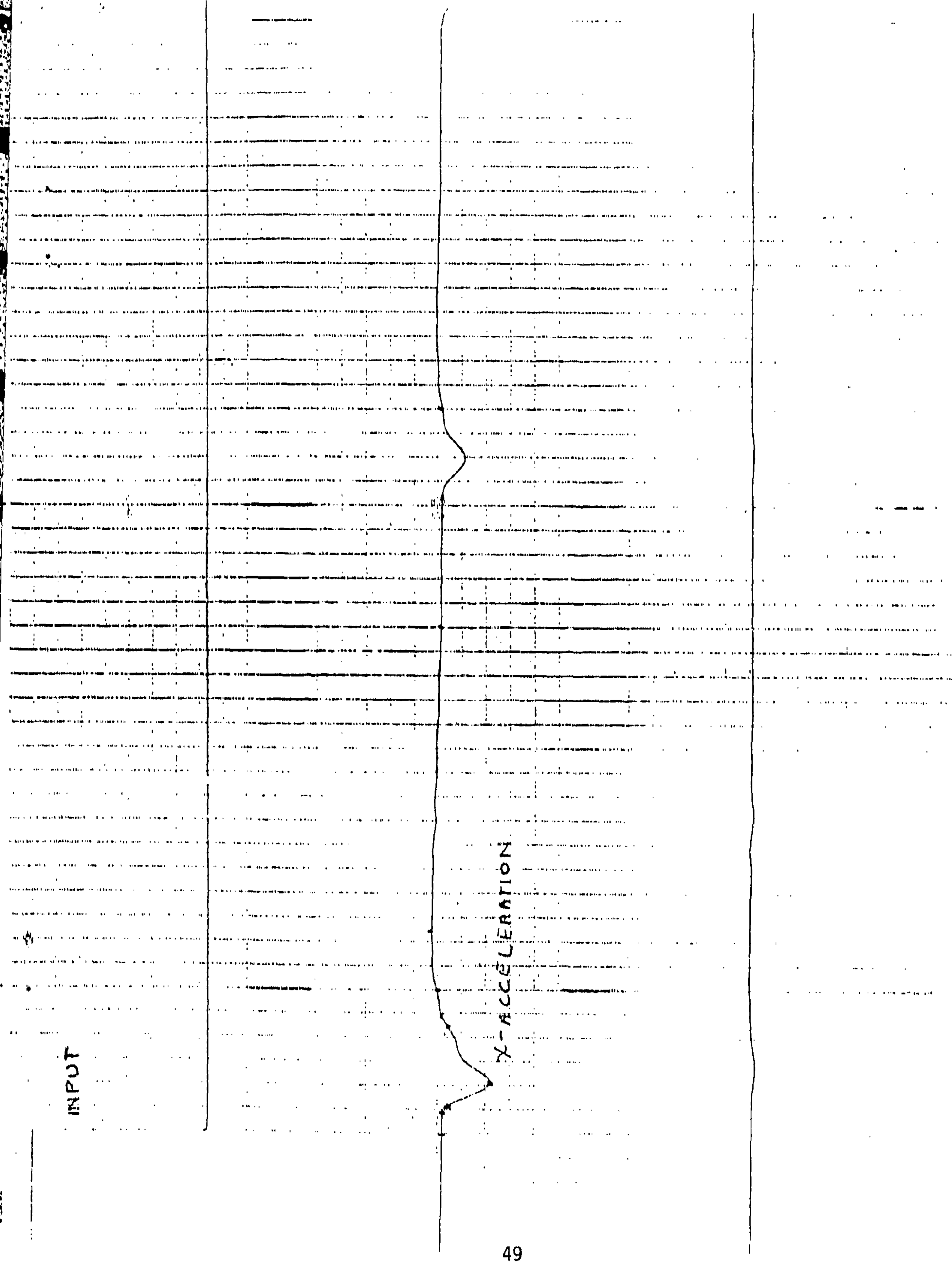

FIGURE 5

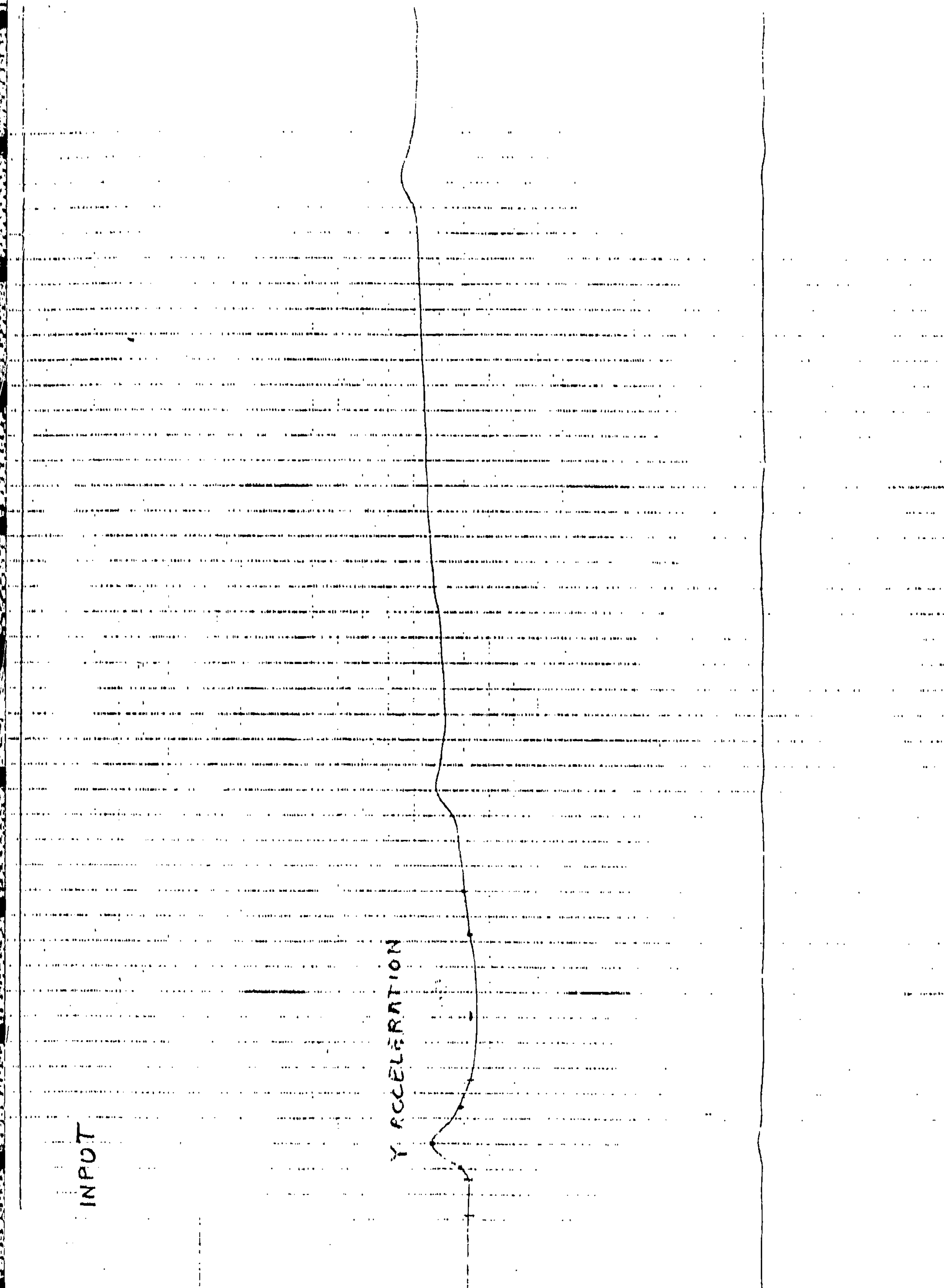

FIGURE 6

TABLE I

Excit. AXA (Ft/Sec^2)	Thruput Time (MSEC)	Peak Onset Mag (G'S)	Onset Pulse Width (MSEC)	Washout Pulse Width (SEC)	Peak Washout Amp (G's)	Time to Onset Peak (MSEC)	Time to Washout Peak (MSEC)	Sustain Accel Mag (G's)	Time to Reach Sustain Peak (SEC)	OBSERVATIONS/ COMMENTS
-10	140/200	0.16	300/140	NA	0.02	120	NA	0	NA	Secondary Pulses — 4.7 Sec
+10	160/220	0.20	400/150	NA	0	140	NA	0	NA	Secondary Pulses 0.08G 300 MSEC
-20	140/180	0.28	380/220	1.1	0.07	120	400	0	NA	Sec Onset Mag = .08G, PW 300MS, about 4.4 sec
+20	100/140	0.28	380/220	0.84	0.06	120	370	0	NA	Sec Ons. Mag = .12G PW = 260MS
+30	160/210	0.40	360/240	1.8	0.11	130	380	0	NA	Sec Ons = .09G PW = 24[illegible]
-30	85/115	0.44	380/320	1.6	0.08	130	360	0	NA	Sec Ons= 0.2G PW = 22[illegible]
+40	125/165	0.52	400/300	1.4	0.12	135	380	0	NA	" " "
-40	80/120	0.52	470/340	1.2	0.09	140	260	0	NA	0.24G's 300 MS
+50	110/150	0.60	440/340	1.6	0.18	140	440	0	NA	Sec Ons. PW=0.24G's PW=275MS
-50	120/160	0.56	480/320	1.3	0.14	140	440	0	NA	SO= 0.24G PW= 275MS
+60	100/140	0.66	400/300	1.5	0.24	130	630	0	NA	SO pk= 0.23G PW = 300MS
-60	110/150	0.66	500/320	1.2	0.16	140	460	0	NA	" 0.24G " "

TABLE 2

Excita. AYA (Ft/Sec^2)	Thruput Time (MSEC)	Peak Onset Mag (G's)	Onset Pulse Width (MSEC)	Washout Pulse Width (SEC)	Peak Washout Amp (G's)	Time to Onset Peak (MSEC)	Time to Washout Peak (SEC)	Sustain Accel Mag (G's)	Time to Reach Sustain Peak (SEC)	COMMENTS		
+10	150/230	0.14	380/110	NA	NA	125	NA	0.12	4.7	Sustain. Accel developed by rolling platform.		
-10	110/170	0.14	320/115	NA	NA	120	NA	0.20	2.9			
-20	110/170	0.24	400/180	NA	NA	140	NA	0.24	4.55			
+20	140/200	0.26	400/220	NA	NA	150	NA	0.20	4.3			
-30	80/140	0.36	440/260	NA	NA	150	NA	0.24	4.3	2nd pulses becoming prominent at this accel magnitude ≈ 0.24g		
+30	140/180	0.36	360/270	NA	NA	120	NA	0.20	4.9	"	"	"
+40	120/170	0.40	360/260	0.8	0.08	150	0.4	0.20	5.4	"	"	"
-40	80/110	0.40	380/260	-	-	140	-	0.24	5.5	"	"	"
	NO HIGHER COMMANDS ISSUED DUE TO VIOLENT BEHAVIOR											

TABLE 3

Excitat. AZA (Ft/Sec^2)	Thruput Time (MSEC)	Peak Onset Amp (G's)	Onset Pulse Widths (MSEC)	Washout Pulse Width (SEC)	Peak Washout Amp (G's)	Time to Onset Peak (MSEC)	Time to Washout Peak (MSEC)	Sustain Accel Mag (G's)	Time to Sustain Peak (SEC)	COMMENTS		
+10	140/180	0.18G	260/160	-	-	100	-	-	-	Secondary Pulses 340 MS		0.12
-10	100/140	0.17	240/130	-	-	110	-	-	-	"	"	"
-20	80/130	0.22	260/150	-	-	120	-	-	-	" 200 MS		0.12
+20	120/150	0.36	430/270	-	-	120	-	-	-	"	"	"
+30	80/110	0.48	430/320	-	-	120	-	-	-	" - 200MS		0.18
-30	130/150	0.40	370/260	1.6	0.12	100	500	-	-	" -300MS		0.30
+40	80/120	0.60	430/310	1.4	0.12	130	440	-	-	"	"	"
-40	120/160	0.48	400/280	1.66	0.12	130	560	-	-	"	"	"
-50	100/140	0.60	460/260	1.8	0.16	130	840	-	-	-300MS		0.25
+50	80/110	0.72	420/380	1.64	0.14	140	640	-	-	" -300MS		0.3
+60	80/110	0.72	360/240	2.04	0.24	120	840	-	-	" -320MS		0.3
-60	SYSTEM	DUMPED	HIT LIMIT	SWITCH								

LABORATORY SERVICES BRANCH, TECHNICAL SUPPORT DIRECTORATE
CALIBRATION DATA SHEET   CAL DATE: 14-DEC-82

VEHICLE: SH-60
PARAMETER: +-1 G
MNEMONIC:
CAL APPAR: C/G TABLE
INPUT VOLTAGE: 28.014 DC
SEQUENCE NUMBER:
DATA CHANNEL:
JOB ORDER NUMBER: NL22009RW
REMARKS: FLIP FLOP:+1G=+5.0158 VDC
: 0G=+2.5175 VDC
:-1G=+27.037E-3 VDC
OUT IMP = 4.754 K OHMS

XDUCER MANUFACTURER: SYSTRON DONNER
XDUCER M/N: 4311A-1-P57
XDUCER S/N: 3581
CAL PERSONNEL: PC
CAL TEMP: 76 DEG F
REQUEST NUMBER:
DATA FILE: DATA10830.CAL

STANDARD	OUTPUT		TM CONV	DEV LSBF	
G,S	VDC	VDC/VOLT		G,S	%FSO
-1.00	0.0185	0.0007		-0.000	-0.0087
-0.80	0.5200	0.0186		-0.001	-0.0375
-0.60	1.0220	0.0365		-0.002	-0.0762
-0.40	1.5219	0.0543		-0.001	-0.0725
-0.20	2.0149	0.0719		0.001	0.0674
0.00	2.5145	0.0898		0.002	0.0766
0.20	3.0217	0.1079		-0.001	-0.0661
0.40	3.5185	0.1256		0.000	0.0001
0.60	4.0142	0.1433		0.002	0.0861
0.80	4.5179	0.1613		0.000	0.0129
1.00	5.0263	0.1794		-0.003	-0.1529
1.00	5.0250	0.1794		-0.003	-0.1270
0.80	4.5164	0.1612		0.001	0.0436
0.60	4.0124	0.1432		0.002	0.1224
0.40	3.5140	0.1254		0.002	0.0895
0.20	3.0166	0.1077		0.001	0.0355
0.00	2.5168	0.0898		0.001	0.0319
-0.20	2.0186	0.0721		-0.000	-0.0070
-0.40	1.5194	0.0542		-0.000	-0.0226
-0.60	1.0207	0.0364		-0.001	-0.0499
-0.80	0.5190	0.0185		-0.000	-0.0182
-1.00	0.0144	0.0005		0.001	0.0729

MAX. DEV.(%FSO)= 0.153   RMS DEV.(%FSO)= 0.071

LEAST SQUARES BEST FIT (LSBF): ORDER(1)   X= VDC
G,S= (-0.1007219E+01) + (0.3999525E+00)X

CORRELATION COEFFICIENT: 0.9999975

TABLE 4

LABORATORY SERVICES BRANCH, TECHNICAL SUPPORT DIRECTORATE
CALIBRATION DATA SHEET   CAL DATE: 14-DEC-82

VEHICLE: SH-60
PARAMETER: +-3 G,S
MNEMONIC:
CAL APPAR: C/G TABLE
INPUT VOLTAGE: 28.005 DC
SEQUENCE NUMBER:
DATA CHANNEL: 1
JOB ORDER NUMBER: NL22009RW
REMARKS: FLIP FLOP: +1G=+3.3329 VDC
: 0G=+2.4960 VDC
: -1G=+1.66947 VDC
OUT IMP = 4.985 K OHMS

XDUCER MANUFACTURER: SYSTRON DONNER
XDUCER M/N: 4311A-3-58
XDUCER S/N: 3582
CAL PERSONNEL: PC
CAL TEMP: 76 DEG F
REQUEST NUMBER:
DATA FILE: DATA10836.CAL

STANDARD	OUTPUT		TM CONV	DEV LSBF	
G,S	VDC	VDC/VOLT		G,S	%FSO
-3.00	0.0103	0.0004		-0.003	-0.0495
-2.50	0.4298	0.0153		-0.008	-0.1324
-2.00	0.8448	0.0302		-0.008	-0.1254
-1.50	1.2552	0.0448		-0.002	-0.0264
-1.00	1.6670	0.0595		0.003	0.0441
-0.50	2.0821	0.0743		0.003	0.0483
0.00	2.4938	0.0890		0.007	0.1212
0.50	2.9088	0.1039		0.008	0.1282
1.00	3.3311	0.1189		-0.001	-0.0118
1.50	3.7471	0.1338		-0.001	-0.0246
2.00	4.1609	0.1486		0.000	0.0072
2.50	4.5782	0.1635		-0.002	-0.0331
3.00	5.0007	0.1786		-0.011	-0.1751
3.00	5.0012	0.1786		-0.011	-0.1857
2.50	4.5780	0.1635		-0.002	-0.0293
2.00	4.1594	0.1485		0.002	0.0363
1.50	3.7445	0.1337		0.002	0.0283
1.00	3.3292	0.1189		0.002	0.0269
0.50	2.9082	0.1038		0.008	0.1409
0.00	2.4913	0.0890		0.010	0.1713
-0.50	2.0795	0.0743		0.006	0.1014
-1.00	1.6633	0.0594		0.007	0.1185
-1.50	1.2516	0.0447		0.003	0.0450
-2.00	0.8420	0.0301		-0.004	-0.0694
-2.50	0.4289	0.0153		-0.007	-0.1153
-3.00	0.0098	0.0004		-0.002	-0.0396

MAX. DEV.(%FSO)= 0.186   RMS DEV.(%FSO)= 0.096

LEAST SQUARES BEST FIT (LSBF), ORDER(1)   X= VDC
G,S= (-0.3009432E+01) + (0.1203834E+01)X

CORRELATION COEFFICIENT: 0.9999953

TABLE 5

APPENDIX B

SAMPLE SYLLABUS GRADE CARD AND SCENARIO (ASF-4)

HS 1 (TAEG) FORM REV 01 (04 MAR 82)

ASF4

FRP: ____________ COMPLETE? YES

INSTRUCTOR: ____________ NO (M S O)

DATE: / / PILOT TIME: ____________

COPILOT TIME: ____________ NAME: ____________

TASK	DESCRIPTION	QUALIFIED	COND QUAL	UNQUAL	DICUSS, INTRO, NOT OBS	TRIALS
BE200	RUNNING TAKEOFF					
BB100	INSTRUMENT DEPARTURE					
FJ200	BLADE STALL					
FJ100	POWER SETTLING					
BE402	TACAN APPROACH					
BE409	MISSED APPROACH					
CB100	SINGLE ENG APPR/LAND RUNWAY					
CB500	SINGLE ENGINE WAVEOFF					
CB600	SINGLE ENG TAKEOFF ABORT					
CA100	AUTOROTATION					
BE600	RUN ON LANDING					
BE300	INSTRUMENT TAKEOFF					
BE404	ASR APPROACH					
AG200	ROTOR DISENGAGEMENT					
BG400	COMMUNICATIONS					
BA500	NORMAL PROCDRS CHECKLISTS					
FD800	ENGINE MALFUNCTION ANALYSIS					
FI772	ROTOR BRAKE CAUTION LIGHT					
FI795	BLADE DAMPNER FAILURE					
FC775	TRANSMISSION SYS MALF'S					
FE798	TAIL RTR CONTROL CABLE LOSS					
FA973	FIRE EXTINGUISHER C.B.					
CE600	EMERGENCY PROCDRS CHECKLISTS					

HS 1 (TAEG) TRAINING FORM REV. 01 (04 MAR 82) ASF-4

SIDE 2

QUALIFIED

COND QUALIFIED

UNQUALIFIED

NUMBER TRIALS/ PROFICIENCY

TASK CODE

COCKPIT PROCEDURE

PREPARATION

HEADWORK

DISCUSS SINGLE ENGINE OPERATIONS

TAIL ROTOR MALFUNCTIONS

SYSTEMS KNOWLEDGE:

TASK CODE	TASK COMMENTS

INSTRUCTOR SIGNATURE

TRAINING OFFICER REVIEW

SIGNATURE

ASF-4 SIMULATOR SCENARIO

OBJECTIVE

An objective of this flight is to continue developing instrument skills. At the completion of this flight, the student should be able to (1) plan and fly a flight under simulated instrument conditions requiring an instrument departure, airways navigation, and terminal procedures and (2) cope with malfunctions while operating under instrument conditions. A second objective is to introduce the student to unusual flight characteristics of the SH-3 aircraft when operating under max gross conditions, encountering blade stall or power settling. The third objective is to introduce complex emergencies such as dual engine failure, autorotations, single engine landings, and takeoff aborts.

BRIEFING INFORMATION

Characteristics of blade stall and power settling are disussed in PQS 0102, Flight Characteristics Theory. Students should be briefed on the conditions expected and the manner in which the other malfunctions and emergencies to be introduced are handled. In addition, the following items should be briefed:

CREW BRIEF FOR THIS SIMULATOR FLIGHT

CREW BRIEF

1. Flight Gear
2. Ditching
   a. Overland
      (1) Controlled
      (2) Uncontrolled
   b. Overwater
      (1) Controlled
      (2) Uncontrolled
3. Lookout

COPILOT BRIEF

1. Cockpit Coordination
   a. Checklist Method
   b. Practice Autorotation
   c. Practice Single Engine
   d. Power/Scan Backup
2. Communications Responsibilities IFR/VFR
3. Vertigo/Disorientation
   a. Notification
   b. Parameters
4. Emergencies
   a. Control of Aircraft
   b. Dual Concurrence
   c. Immediate Action
      (1) Engine Fire
      (2) Engine Malfunction
      (3) Hardover
      (4) Tail Rotor Loss
      (5) Dual Engine Loss
      (6) Others: Use Check-lists

SPECIAL BRIEFING ITEMS FOR THIS FLIGHT

1. Aircraft/Simulator Start

   a. Interior and exterior preflight inspections--complete
   b. Aircraft has been previously flown today; both engines are running and blades are spread
   c. Complete all checklists applicable for this flight

2. Communications

   Make all applicable radio calls. The call sign of today's aircraft is "ALPHA ROMEO________."

3. Taxi, Takeoff, and Flight

   a. Taxi
   b. Takeoff
   c. Tasks to be trained or manuevers to be performed on this flight.

4. Flight Equipment

   Helmet
   Boots
   Flight suit
   Gloves
   Dog tags
   Knee board

5. Flight Publications Required

   En route Low Altitude Charts 19/20
   Vol. 12, Low Altitude Instrument Approach Procedures, S.E.
   IFR and VFR Supplements
   Jacksonville Sectional Chart

FREQUENCIES THAT MAY BE REQUIRED ON THIS FLIGHT
Frequency and Channelization card.

PROCEDURES AND SCENARIO FOR ASF-4

1. Simulator setup

   a. Check safety mat free of objects, ramp, and walkway clear.

   b. Lower safety bar and close door.

   c. Raise ramp, check up light illuminates when ramp retracted.

   d. Students briefed on Emergency Egress from trainer.

   e. Safety belts fastened.

   f. MASTER power, TRAINER power, and FREEZE illuminated.

   g. MAT, DOOR, HI TEMP, LOW OIL, GATE, and RAMP indicators out.

   h. FREEZE--ON.

   i. MOTION--ON.

2. Ensure rotor brake is on. SELECT IC No. 4 and enter. Engines running and blades spread. Gross weight 21,000, wind 240/6 and temperature 35 degrees C.

   a. FREEZE--OFF.

   b. Enter (.794), blade out of track

   c. Clear malfunction and complete engagement after action on malfunction.

3. Before Taxi:

   Call sign for today is "ALPHA ROMEO ______."

   a. Contact Clearance Delivery

(1) If clearance previously filed, "Navy JAX Clearance Delivery, ALPHA ROMEO ______, NIP 32 to Mayport." (If not, include ETD, ETE and Wx Brief number.)

(2) "ALPHA ROMEO ______, Navy JAX Clearance Delivery, clearance on request."

b. Taxi Checklist

(1) "ALPHA ROMEO ______, Navy JAX Clearance Delivery, advise when ready to copy clearance."

(2) "Navy JAX Clearance Delivery, ALPHA ROMEO ______, ready to copy."

(3) "ATC clears ALPHA ROMEO ______ as filed. After takeoff, maintain runway heading; climb to 2000. One West of Navy JAX turn right to heading 360. Expect 4000, 10 minutes after departure. Contact Departure Control on frequency 351.8, Squawk Mode 3, Code 0401. Readback."

(4) Readback.

(5) "ALPHA ROMEO ______, readback correct; contact Navy JAX ground control when ready to taxi."

c. Taxi Clearance

(1) "Navy JAX Ground Control, ALPHA ROMEO ______, taxi, IFR to Mayport."

(2) "ALPHA ROMEO ______, Navy JAX Ground Control wind 240/6 knots, altimeter 29.92, cleared to taxi to and hold short of Runway 27. Over."

(3) "ALPHA ROMEO ______."

4. Before Takeoff:

a. Instructor/student brief

b. Pre-Takeoff Checklst

c. Takeoff Checklist

d. Request Takeoff Clearance.

(1) "Navy JAX Tower, ALPHA ROMEO _____ ready for takeoff, IFR to Mayport."

(2) "ALPHA ROMEO _____, wind 240/5 knots cleared for takeoff, maintain runway heading after takeoff, change to Jacksonville Departure Control."

5. Max Gross Running Takeoff IFR:

Contact Departure and complete Post-Takeoff Checklist.

a. "Jacksonville Departure, Navy Copter ALPHA ROMEO _____, off Navy JAX, climbing to 2000.

b. "ALPHA ROMEO _____, radar contact, turn right to heading 360 and report reaching 2000."

c. Report 2000 feet.

d. "Roger ALPHA ROMEO _____, turn right to heading 060, climb to and maintain 4000."

e. Acknowledge and report leaving 2000.

6. Instructor establish conditions to demostrate onset of blade stall or use DEMO No. 1.

a. At onset of blade stall have student recover. Freeze trainer if necessary to prevent loss of control.

b. Establish controlled flight.

c. If DEMO used: Press DEMO switch. (Note segment light will illuminate and show a "0" if a briefing is available or a "1" if demonstration maneuver only is available.)

7. Power Settling.

a. Establish flight conditions that could lead to power settling and recovery. Press FREEZE. At Select Digi Switches, enter DEMO 9 for power settling demonstration.

b. At conclusion of Demo, trainer should freeze and return to position prior to Demo.

c. Establish normal flight en route to PARNEL. Reduce gross weight to 19,000 lbs. and temperature to 15 degrees. (Notify student.)

d. Establish normal flight en route to PARNEL.

8. Clearance to PARNEL.

a. "ALPHA ROMEO ______, cleared direct to PARNEL. Enter published holding. Maintain 4000. Expect approach clearance at ____. Over."

b. "ALPHA ROMEO ______."

c. "Jacksonvile Approach, ALPHA ROMEO ______ at 4000."

d. "ALPHA ROMEO ______, Jacksonville Approach, Radar temporarily out of service. Report established in holding at PARNEL."

e. Report PARNEL.

f. "ALPHA ROMEO ______, JAX Approach, descend to and maintain 2000."

g. "Jacksonville Approach, ALPHA ROMEO ______, out of 4000 for 2000."

9. Holding and Aproach. Allow student to enter holding and make at least one pattern with clearance on second inbound, time permitting. (Mayport Approach Map.) One minute legs in holding pattern to expedite.

Approach Clearance

a. "ALPHA ROMEO ______ is cleared for a TACAN 22 approach to Mayport."

b. Acknowledge

c. After established on the arc issue: "ALPHA ROMEO ______ contact Mayport Tower 265.8." Acknowledge.

d. "ALPHA ROMEO ______, Mayport Tower, altimeter ____, Mayport weather 500 broken, 2 miles visibility, fog, wind 210/6. Report 4 mi DME." Acknowledge and report 4 DME.

e. "ALPHA ROMEO ______ wind 210/6, cleared to land. Check landing gear down and locked." Acknowledge.

10. At minimums advise student that field is not in sight. He should execute a missed approach.

a. "Mayport Tower, ALPHA ROMEO ______, missed approach, request clearance to Jacksonville Approach."

b. "ALPHA ROMEO ______, contact Jacksonville Approach on 381.5."

c. Acknowledge and contact JAX.

d. "ALPHA ROMEO ______, left turn to intercept the 075 radial of Mayport, cleared to PARNEL. Over."

e. Acknowledge.

f. "JAX approach, ALPHA ROMEO ______, cancel my IFR at this time."

g. Freeze Trainer. Show student track on CRT or print copy for debrief.

11. Single Engine Malfunction Analysis:

a. Select a malfunction that will cause engine failure or require the student to shut the engine down such as Lube Pump Shaft Failure (.803/.804) or engine fire (.815/.816). For delayed malfunction use number preceded by a minus (-) instead of a point (.).

b. Enter. If delayed malfunction press MALF's INSERT switch.

c. Single Engine Checklist.

12. Single Engine Operations:

Landing Clearance

a. "Mayport Tower, ALPHA ROMEO ____ miles East of Mayport at ____ ft. Lost No. ____ engine, request landing and emergency equipment standing by."

b. "ALPHA ROMEO ______, Mayport Tower, cleared to land Runway 22 or Pad 2; wind 200/7 knots, altimeter 29.93. Report channel entry with gear."

c. Complete landing checklist and single engine landing approach.

13. Single engine waveoff:

a. At an appropriate time before touchdown, instructor direct waveoff, continue around for another approach to touchdown. If additional approaches are needed reset trainer to pattern altitude for another approach.

b. After Landing Checklist, as required, preparatory for the next takeoff. Delete all previous malfunctions.

14. Single Engine Malfunction on Takeoff/Abort:

a. Call up .839/.840 for axial shaft failure which will cause flameout when activated.

b. Complete Pre-Takeoff and Takeoff Checklists as required.

c. Begin Takeoff.

d. Enter malfunction unless delayed malfunction procedure has been entered, then press MALF INSERT.

e. Upon completion of abort. Freeze the trainer and reset to inflight at Mayport. (IC-8)

15. Main Gear Box Malfunctions. Select MGB Chip Light (.782), immediate loss of transmission oil pressure (.777), or transmission oil overheat (.786).

a. Enter malfunction code.

b. After required malfunction action is completed and checklist completed, delete malfunction by punching in Malfunction Override.

16. Takeoffs and Landings. At least two.

17. Autorotations. Position aircraft for autorotations at Mayport or assume autorotation at night on instruments. Recommend demonstration No. 2.

a. Press Freeze. At Select Digi Switches, enter 2 for demonstration.

(1) Press DEMO switch. (Note: segment light will illuminate and show a "0" if a briefing is available or a "1" if demonstration maneuver only is available.)

(2) Press Freeze and briefing will begin. Upon completion of briefing,

(3) Press Freeze and demonstration will begin.

b. At conclusion of Demo, trainer should freeze and return to position prior to Demo.

18. Autorotation should be practiced to the ground. The student is being trained to cope with an emergency, not for practice in power recoveries.

Reset to appropriate altitude for subsequent practice. At least one dual engine failure should be given. Malfunctions .839 and .840 if given simultaneously should set up condition to flameout both engines. Altitude can be varied from 500 feet up in accordance with student performance. Caution: recommend that not more than 5 or 6 be given without a significant break to do other type training. After practicing autorotations resulting from malfunctions, practice autorotations with power recovery.

19. Run On Landing. Have student do one or more run on landings at Mayport. Upon completion of this practice interrupt for change of students.

20. Landing:

    a. After landing checklist

    b. Refueling in accordance with hot seat procedures. (Perform hand signals.)

    c. Shutdown No. 2 engine and rotor disengagement.

    d. Freeze for change of pilots.

21. Simulator Shutdown:

    a. Freeze--PRESSED

    b. Motion--PRESSED, light extinguished

    c. Lower RAMP--Down light illuminated

    d. Unlatch and raise safety bar.

ASF-4 SIMULATOR SCENARIO, STUDENT NO. 2

1. Simulator Setup:

    a. Check safety mat free of objects, ramp and walkway clear.

    b. Lower safety bar and close door.

    c. Raise ramp and check UP light illuminated when ramp raised.

    d. Students--briefed on EMERGENCY EGRESS FROM TRAINER

    e. Safety belts fastened.

    f. MASTER POWER, TRAINER POWER, and FREEZE lights illuminated.

    g. MAT, DOOR, HI TEMP, LOW OIL, GATE and RAMP indicator lights out.

    h. MOTION--ON.

    i. Ensure all systems are ON and rotor brake is ON

    j. Initiate problem with No. 1 engine running, blades spread, and system check complete. Verify internal cargo to 700; crewmen to 2; increase fuel to 2359 Fwd, 1006 Center, Aft 2400 (gross should be about 21,000) Temp to 35 degrees C.

2. All other conditions remain the same. Select malfunction. Blade dampner failure (.795).

    a. FREEZE--OFF

    b. Enter Malfunction selected

    c. Clear malfunction and complete engagement.

3. Before Taxi:

    a. Taxi Checklist

    b. Taxi Clearance.

4. Before Takeoff:

   a. Pre-takeoff Checklist

   b. Takeoff Checklist

   c. Instructor brief on max gross takeoff procedure, high speed flight and blade stall.

5. Takeoff:

   Takeoff Clearance

   a. "Mayport Tower, ALPHA ROMEO ______, ready for takeoff; request JAX 1 departure."

   b. "ALPHA ROMEO ______, cleared to lift, right turn after takeoff, JAX 1 departure approved. Wind 240/8, altimeter 29.92."

   c. Takeoff

   d. Post-takeoff Checklist.

6. High Speed Flight

   Continue until onset of blade stall; if stall occurs and student is unable to recover, freeze the trainer.

7. Power Settling. Demonstration mode can be used or instructor can allow student to perform. If Demo used, refer to procedure used for first student.

   a. Instructor establish conditions to induce power settling. After recovery or freeze, reduce gross weight to 19,000 and temperature to 15 degrees C. (Notify student.)

   b. Establish normal flight.

8. Call up malfunctions that will lead to single engine operation: Lube Pump Shaft (.803/.804), engine fire (.815/.816), or immediate loss of oil pressure (.807/.808) and high oil temp (.811/.812).

9. Engine Malfunction Analysis:

   a. Enter Malfunction selected

   b. Single engine checklist.

10. Single Engine Operations:

    a. Landing clearance for Mayport

    b. Landing Checklist

    c. Single engine missed approach

    d. Single engine landing

    e. Reset to final approach if additional landing practice required.

11. Single Engine Malfunction Takeoff/Abort. Call up .839 or .840 for flameout.

    a. Brief for takeoff

    b. Complete checklists and request takeoff

    c. Begin takeoff

    d. Enter malfunction.

12. After aborted takeoff, freeze, clear malfunction and reset for another takeoff at Mayport. Practice a minimum of 2 Takeoffs and Landings.

13. Main Gear Box Malfunction. Call up Transmission Malfunction (.776 to .789); identify malfunction given on grade card.

    a. Enter malfunction, after ompletion of required action and completion of checklist.

    b. Clear malfunction.

14. Tail Rotor Control Loss. Call up rotor control cable loss (.798).

Complete recovery with landing.

15. Autorotations. Practice autorotations to ground at Mayport; at least one should be induced by malfunctions such as dual engine failure (.839 and .840). Use IC 17 for reset to 800

16. Instrument Takeoff and Departure.

a. Pre-Takeoff and Takeoff Checklist

b. IFR Mayport to NAS Jacksonville for TACAN Approach to NAS Jacksonville.

(1) "Mayport Ground Control, ALPHA ROMEO ______, IFR to Navy JAX, request clearance."

(2) "ALPHA ROMEO ______, is cleared as filed, maintain runway heading climb to 1000, right turn heading 240 degrees, climb to 3000. Contact Jacksonville Departure on 322.4, squawk 0402. Readback."

(3) Readback

(4) "Readback correct. Contact Mayport Tower on 265.8 when ready for takeoff."

17. Takeoff:

a. "Mayport Tower, ALPHA ROMEO ______, ready for takeoff, IFR to Navy JAX."

b. "ALPHA ROMEO ______, cleared to lift; wind 220/10, change to JAX Departure, begin squawk."

18. After takeoff:

a. Contact Jacksonville Departure

(1) "Jacksonville Departure, Navy Copter ALPHA ROMEO ______, off Mayport, maintaining runway heading."

(2) "ALPHA ROMEO ______, this is Jacksonville Departure, radar contact, turn right heading 240 degrees, maintain 3000."

(3) "ALPHA ROMEO ______."

b. Post-Takeoff Checklist.

19. En route discuss communications failures.

20. Terminal Procedures

a. "ALPHA ROMEO ______, this is Jacksonville Departure, contact Jacksonville Approach on 284.6. Over."

b. "Jacksonville Approach, ALPHA ROMEO ______, at 3000."

(1) "ALPHA ROMEO ______, this is Jacksonville Approach, cleared to MANDARIN via radar vectors, maintain 3000, expect further clearance at ____."

(2) "ALPHA ROMEO ______."

(3) "ALPHA ROMEO ______, JAX Approach, Navy JAX weather 500 overcast, 1 mile visibility, fog, wind 180/10, altimeter 29.92. Landing Runway 9."

c. Vector student to MANDARIN, check entry into holding pattern, time and procedures, wind corrections and preparation for a TACAN Approach. Landing Cecklist. Slew to approximately 5 N.E. of MANDARIN; inform student.

(1) "ALPHA ROMEO _____, cleared for TACAN 9 to Navy JAX, report leaving MANDARIN."

(2) "Jacksonville Approach, ALPHA ROMEO ______, leaving MANDARIN."

(3) At 6 mile arc, "ALPHA ROMEO ______, contact Navy JAX RADAR on frequncy 374.8."

(4) "ALPHA ROMEO ______."

(5) "Navy JAX RADAR, ALPHA ROMEO ______."

(6) "ALPHA ROMEO ______, Navy JAX RADAR, Radar contact, descend to and maintain 1600, report 5 DME on final."

(7) "ALPHA ROMEO ______."

(8) "Navy JAX RADAR, ALPHA ROMEO ______, at 5 mi DME inbound."

(9) "ALPHA ROMEO ______, Navy JAX RADAR, continue approach, expect further clearance at 3 miles."

(10) At 3 miles, "ALPHA ROMEO ______, you are cleared to land, wind 180/10."

(11) "ALPHA ROMEO ______."

21. Instructor. At minimums do not call field in sight; have student execute missed approach.

Missed approach:

a. "Navy JAX RADAR, ALPHA ROMEO ______, executing missed approach, request ASR approach to Navy JAX."

b. "ALPHA ROMEO ______, contact Jacksonville approach this frequency."

c. Acknowledge

d. "Jacksonville Approach, ALFHA ROMEO ______, missed approach to Navy JAX request ASR approach."

e. "ALPHA ROMEO ______, turn right, climb to 1600 on the 185 radial of Navy Jacksonville TACAN." Instructor vector for base leg to Runway 27 then

f. "ALPHA ROMEO ______, JAX Approach, contact Navy JAX RADAR this frequency for ASR approach."

g. "Navy JAX RADAR, ALPHA ROMEO ______."

22. Instructor. Direct ASR Approach in the following manner. Bring up JAX Approach Map for vectors to final and then GCA Map for Runway 27. Instructor will be required to issue commands as steering commands for an ASR are not issued by computer.

a. "ALPHA ROMEO ______, Radar Contact, ____ miles ____ of Navy JAX. This will be a surveillance approach to Runway 27. What are your landing intentions?"

b. "Navy JAX RADAR, ALPHA ROMEO ______, this will be a final landing."

(1) "ALPHA ROMEO ______, Navy Jacksonville weather ceiling 500 overcast, 1 mile visibility, fog, wind 180/10, altimeter 29.92."

(2) "ALPHA ROMEO ______, your missed approach procedure is climb and maintain 1600, 1 mile west of Navy JAX TACAN turn left heading 170 degrees."

c. On downwind or base leg, call for landing checklist.

"ALPHA ROMEO ______, perform landing checklist."

d. After turn on final

(1) "ALPHA ROMEO ______ this is your final controller, wheels should be down. Over."

(2) Acknowledge wheels down and locked and student should request recommended altitudes during the approach.

e. At 6-1/3 miles issue

(1) "ALPHA ROMEO ______, 6-1/3 miles from runway, prepare to descend in 1 mile, minimum descent altitude 480. Report runway in sight."

(2) "Five miles from runway, your altitude should be 1520."

f. Issue altitude information in accordance with the following at

4 miles - 1220

3 miles - 920

2 miles - 620

g. As required, "Heading ____, ____ miles from runway." At least once each mile, "Altitude should be ____."

h. On course or slightly left/right of course, and trend information as appropriate.

i. At 2-1/2 miles, "2-1/2 miles from runway, wind ____ at ____, cleared to land."

j. "1 mile from runway, take over visually; if runway/runway lights/approach lights not in sight, execute missed approach. Over."

23. Upon completion of ASR approach and Run on landing, clear aircraft to shutdown in present position.

"ALPHA ROMEO ______, cleared to shutdown in present position. Winds 240/8."

24. After landing checklist:

Engine Fire No. 1 on ground (.815).

a. Enter .815

b. Fire extinguisher circuit breaker (.973)

c. Enter .973

25. Simulator Shutdown. Perform the following:

a. Freeze--ON

b. Motion Switch--Pressed, light extinguished

c. Lower Ramp--DOWN light illuminated

d. Unlatch and raise safety bar. Stow in up position.

APPENDIX C

REPRESENTATIVE SAMPLE OF TASKS AND TASK CHARACTERISTICS

TABLE C-1. REPRESENTATIVE SAMPLE OF TASKS AND TASK CHARACTERISTICS

	Easy or Difficult	Normal or Degraded Aircraft Operation	Transition or Mission Oriented
Normal Approach	Difficult	Normal	Transition
Normal Takeoff	Easy	Normal	Transition
Normal Landing	Easy	Normal	Transition
Running Takeoff	Easy	Normal	Transition
ASE Off Takeoff	Difficult	Degraded	Transition
Freestream Recovery	Difficult	Degraded	Mission Oriented
Alternate Approach Pilot Procedures	Difficult	Normal	Mission Oriented
Coupled Hover Departure Procedures	Easy	Normal	Mission Oriented
SAR Search	Difficult	Normal	Mission Oriented

APPENDIX D

INTERCORRELATION MATRICES, SUMMARY TABLES, REGRESSION COEFFICIENTS AND TESTS OF SIGNIFICANCE FOR "A" STAGE TASK TRIALS TO PROFICIENCY

TABLE D-1. INTERCORRELATION MATRIX FOR NORMAL APPROACH

	(1) Trials to Proficiency	(2) Simulator Training Trials	(3) Simulator Proficiency	(4) Student Ability (UPT Score)	(5) Aircraft Instructor Index	(6) Aircraft Instructor Variability	(7) Average Scheduling Time	(8) Scheduling Variability	(9) Motion
(1) Trials to Proficiency	1.0000000 (26)	.1004202 (26)	.2264252 (26)	-.5880614 (26)	-.3956368 (26)	.3444115 (26)	.5230819 (26)	.6642545 (26)	-.0104406 (26)
(2) Simulator Training Trials	.1004202 (26)	1.0000000 (26)	.0440304 (26)	.0257009 (26)	-.0226984 (26)	.1527125 (26)	.2566844 (26)	.1954427 (26)	.0155521 (26)
(3) Simulator Proficiency	.2264252 (26)	.0440304 (26)	1.0000000 (26)	-.1386269 (26)	-.1706520 (26)	-.1021104 (26)	.1260955 (26)	-.0721157 (26)	.0425136 (26)
(4) Student Ability (UPT Score)	-.5880614 (26)	.0257009 (26)	-.1386269 (26)	1.0000000 (26)	.1624950 (26)	-.0781093 (26)	-.3468786 (26)	-.4702971 (26)	-.0598756 (26)
(5) Aircraft Instructor Index	-.3956368 (26)	-.0226984 (26)	-.1706520 (26)	.1624950 (26)	1.0000000 (26)	-.2490979 (26)	-.3253661 (26)	-.2798693 (26)	-.4608858 (26)
(6) Aircraft Instructor Variability	.3444115 (26)	.1527125 (26)	-.1021104 (26)	-.0781093 (26)	-.2490979 (26)	1.0000000 (26)	.4935011 (26)	.3259257 (26)	-.1579449 (26)
(7) Average Scheduling Time	.5230819 (26)	.2566844 (26)	.1260955 (26)	-.3468786 (26)	-.3253661 (26)	.4935011 (26)	1.0000000 (26)	.7570148 (26)	.0344336 (26)
(8) Scheduling Variability	.6642545 (26)	.1954427 (26)	-.0721157 (26)	-.4702971 (26)	-.2798693 (26)	.3259257 (26)	.7570148 (26)	1.0000000 (26)	-.1645611 (26)
(9) Motion	-.0104406 (26)	.0155521 (26)	.0425136 (26)	-.0598756 (26)	-.4608858 (26)	-.1579449 (26)	.0344336 (26)	-.1645611 (26)	1.0000000 (26)

TABLE D-2. SUMMARY TABLE OF REGRESSION ANALYSIS FOR NORMAL APPROACH

Source	Sum of Squares	df	MS	*F*
Regression	1164.496	3	388.165	8.66*
Residual	986.120	22	44.824	
Total	2150.615	25		

$^*p < .05$

TABLE D-3. REGRESSION COEFFICIENTS FOR VARIABLES PREDICTING TRIALS TO PROFICIENCY FOR NORMAL APPROACH

Variable	Regression Coefficient	*t*-Value
Student UPT Score	-.282326	-2.080*
Scheduling Variability	.929184	3.047*
Motion/No Motion	.966939	.358
Constant (Intercept)	50.445069	--

$^*p < .05$

TABLE D-4. INTERCORRELATION MATRIX FOR NORMAL TAKEOFF

	(1) Trials to Proficiency	(2) Simulator Training Trials	(3) Simulator Proficiency	(4) Student Ability (UPT Score)	(5) Aircraft Instructor Index	(6) Aircraft Instructor Variability	(7) Average Scheduling Time	(8) Scheduling Variability	(9) Motion
(1) Trials to Proficiency	1.0000000 (26)	.1145742 (25)	.3819771 (26)	-.3138649 (26)	-.3030532 (26)	.7285426 (26)	.5047535 (26)	.3733401 (26)	.1214618 (26)
(2) Simulator Training Trials	.1145742 (26)	1.0000000 (26)	.3896245 (26)	-.2282587 (26)	-.1767359 (26)	.2185669 (26)	.1488314 (26)	-.0963799 (26)	.3771051 (26)
(3) Simulator Proficiency	.3819771 (26)	.3896245 (26)	1.0000000 (26)	-.1754277 (26)	-.1644054 (26)	.4269564 (26)	.3444376 (26)	-.2116267 (26)	.1836629 (26)
(4) Student Ability (UPT Score)	-.3138649 (26)	-.2282587 (26)	-.1754277 (26)	1.0000000 (26)	-.2719052 (26)	-.2155010 (26)	-.3178371 (26)	.1150256 (26)	-.0598756 (26)
(5) Aircraft Instructor Index	-.3030532 (26)	-.1767359 (26)	-.1644054 (26)	-.2719052 (26)	1.0000000 (26)	-.0386510 (26)	.0649003 (26)	-.3336811 (26)	-.1685113 (26)
(6) Aircraft Instructor Variability	.7285426 (26)	.2185669 (26)	.4269564 (26)	-.2155010 (26)	-.0386510 (26)	1.0000000 (26)	.7063533 (26)	.2295819 (26)	.2844878 (26)
(7) Average Scheduling Time	.5047535 (26)	.1488314 (26)	.3444376 (26)	-.3178371 (26)	.0649003 (26)	.7063533 (26)	1.0000000 (26)	.0131024 (26)	.2920896 (26)
(8) Scheduling Variability	.3733401 (26)	-.0953799 (26)	-.2116267 (26)	.1150256 (26)	-.3336811 (26)	.2295819 (26)	.0131024 (26)	1.0000000 (26)	-.2160246 (26)
(9) Motion	.1214618 (26)	.3771051 (26)	.1836629 (26)	-.0598756 (26)	-.1685113 (26)	.2844878 (26)	.2920896 (26)	-.2160246 (26)	1.0000000 (26)

TABLE D-5. SUMMARY TABLE OF REGRESSION ANALYSIS FOR NORMAL TAKEOFF

Source	Sum of Squares	df	MS	F
Regression	52.558	4	13.140	11.752*
Residual	23.480	21	1.118	
Total	76.038	25		

*$p < .05$

TABLE D-6. REGRESSION COEFFICIENTS FOR VARIABLES PREDICTING TRIALS TO PROFICIENCY FOR NORMAL TAKEOFF

Variable	Regression Coefficient	t-Value
Instructor Variability	16.332168	5.402*
Instructor Index	-7.158410	-2.935*
Student UPT Flight Score	-.042390	-2.120*
Motion/No Motion	-.540661	-1.228
Constant (Intercept)	16.843002	

*$p < .05$

TABLE D-7. INTERCORRELATION MATRIX FOR NORMAL LANDING

	(1) Trials to Proficiency	(2) Simulator Training Trials	(3) Simulator Proficiency	(4) Student Ability (UPT Score)	(5) Aircraft Instructor Index	(6) Aircraft Instructor Variability	(7) Average Scheduling Time	(8) Scheduling Variability	(9) Motion
(1) Trials to Proficiency	1.0000000 (26)	-.2301179 (26)	-.1593976 (26)	.0646977 (26)	-.4320483 (26)	.4860244 (26)	.6880489 (26)	.4064384 (26)	-.4116324 (26)
(2) Simulator Training Trials	-.2301179 (26)	1.0000000 (26)	-.1884059 (26)	-.0552299 (26)	.2032711 (26)	-.0036203 (26)	-.2660548 (26)	-.1650613 (26)	.0844260 (26)
(3) Simulator Proficiency	-.1593976 (26)	-.1884059 (26)	1.0000000 (26)	.0950007 (26)	.0770367 (26)	-.0962006 (26)	-.1406147 (26)	-.1540316 (26)	.0307258 (26)
(4) Student Ability (UPT Score)	.0646977 (26)	-.0552299 (26)	.0950007 (26)	1.0000000 (26)	-.2711370 (26)	.0070999 (26)	.0643145 (26)	.1616912 (26)	-.0598756 (26)
(5) Aircraft Instructor Index	-.4320483 (26)	.2032711 (26)	.0770367 (26)	-.2711370 (26)	1.0000000 (26)	-.1710652 (26)	-.5322370 (26)	-.0619399 (26)	.3463320 (26)
(6) Aircraft Instructor Variability	.4860244 (26)	-.0036203 (26)	-.0962006 (26)	.0070999 (26)	-.1710652 (26)	1.0000000 (26)	.5074604 (26)	.2320906 (26)	-.3735721 (26)
(7) Average Scheduling Time	.6880489 (26)	-.2660548 (26)	-.1406147 (26)	.0643145 (26)	-.5322370 (26)	.5074604 (26)	1.0000000 (26)	.1710883 (26)	-.3576369 (26)
(8) Scheduling Variability	.4064384 (26)	-.1650613 (26)	-.1540316 (26)	.1616912 (26)	-.0619399 (26)	.2320906 (26)	.1710883 (26)	1.0000000 (26)	-.2152937 (26)
(9) Motion	-.4116324 (26)	.0844260 (26)	.0307258 (26)	-.0598756 (26)	.3463320 (26)	-.3735721 (26)	-.3576369 (26)	-.2152937 (26)	1.0000000 (26)

TABLE D-8. SUMMARY TABLE OF REGRESSION ANALYSIS FOR NORMAL LANDING

Source	Sum of Squares	df	MS	F
Regression	145.290	3	48.430	9.97*
Residual	106.864	22	4.857	
Total	252.154	25		

*$p < .05$

TABLE D-9. REGRESSION COEFFICIENTS FOR VARIABLES PREDICTING TRIALS TO PROFICIENCY FOR NORMAL LANDING

Variable	Regression Coefficient	t-Value
Average Scheduling Time	1.011999	3.952*
Scheduling Variability	1.515294	1.925
Motion/No Motion	-.882356	-.940
Constant (Intercept)	4.403120	

*$p < .05$

TABLE D-10. INTERCORRELATION MATRIX FOR RUNNING TAKEOFF

	(1) Trials to Proficiency	(2) Simulator Training Trials	(3) Simulator Proficiency	(4) Student Ability (UPT Score)	(5) Aircraft Instructor Index	(6) Aircraft Instructor Variability	(7) Average Scheduling Time	(8) Scheduling Variability	(9) Motion
(1) Trials to Proficiency	1.0000000 (26)	-.0138043 (26)	-.0818287 (26)	-.0601215 (26)	-.4539665 (26)	.6120825 (26)	.2583951 (26)	.5766411 (26)	-.2003207 (26)
(2) Simulator Training Trials	-.0138043 (26)	1.0000000 (26)	-.0583182 (26)	-.0405241 (26)	.2437732 (26)	-.3039384 (26)	-.2967381 (26)	-.0611885 (26)	.1257901 (26)
(3) Simulator Proficiency	-.0818287 (26)	-.0583182 (26)	1.0000000 (26)	-.2600790 (26)	-.0284160 (26)	.0433981 (26)	-.1365490 (26)	-.2280996 (26)	.0266529 (26)
(4) Student Ability (UPT Score)	-.0601215 (26)	-.0405241 (26)	-.2600790 (26)	1.0000000 (26)	-.0552867 (26)	-.1376243 (26)	-.2521555 (26)	.0089829 (26)	-.0598756 (26)
(5) Aircraft Instructor Index	-.4539665 (26)	.2437732 (26)	-.0284160 (26)	-.0552867 (25)	1.0000000 (26)	-.1880727 (26)	-.0145092 (26)	-.2959130 (26)	.2097720 (26)
(6) Aircraft Instructor Variability	.6120825 (26)	-.3039384 (26)	.0433981 (26)	-.1376243 (26)	-.1880727 (26)	1.0000000 (26)	.5419202 (26)	.4554040 (26)	-.0989071 (25)
(7) Average Scheduling Time	.2583951 (26)	-.2967381 (26)	-.1365490 (26)	-.2521555 (26)	-.0145092 (26)	.5419202 (26)	1.0000000 (26)	.3506313 (26)	-.2231677 (26)
(8) Scheduling Variability	.5766411 (26)	-.0611885 (26)	-.2280996 (26)	.0089829 (26)	-.2959130 (26)	.4554040 (26)	.3506313 (26)	1.0000000 (26)	-.3587432 (26)
(9) Motion	-.2003207 (26)	.1257901 (26)	.0266529 (26)	-.0598756 (26)	.2097720 (26)	-.0989071 (26)	-.2231677 (26)	-.3587432 (26)	1.0000000 (26)

TABLE D-11. SUMMARY TABLE OF REGRESSION ANALYSIS FOR RUNNING TAKEOFF

Source	Sum of Squares	df	MS	*F*
Regression	41.012	3	13.671	7.310*
Residual	41.141	22	1.870	
Total	82.153	5		

*$p < .05$

TABLE D-12. REGRESSION COEFFICIENTS FOR VARIABLES PREDICTING TRIALS TO PROFICIENCY FOR RUNNING TAKEOFF

Variable	Regression Coefficient	*t*-Value
Instructor Variability	-5.447850	3.517*
Instructor Index	11.182916	-2.146*
Motion/No Motion	-.271933	-.493
Constant (Intercept)	6.857893	

*$p < .05$

TABLE D-13. INTERCORRELATION MATRIX FOR ASE OFF TAKEOFF

	(1) Trials to Proficiency	(2) Simulator Training Trials	(3) Simulator Proficiency	(4) Student Ability (UPT Score)	(5) Aircraft Instructor Index	(6) Aircraft Instructor Variability	(7) Average Scheduling Time	(8) Scheduling Variability	(9) Motion
(1) Trials to Proficiency	1.0000000 (26)	-.1763447 (26)	-.0835656 (26)	-.6165685 (26)	-.2128723 (26)	.4824783 (26)	-.0915943 (26)	.1554045 (26)	.0995624 (26)
(2) Simulator Training Trials	-.1763447 (26)	1.0000000 (26)	.0153752 (26)	.1828765 (25)	.0938033 (26)	.1456246 (26)	.1349154 (26)	.2059962 (26)	.2865341 (26)
(3) Simulator Proficiency	-.0835656 (26)	.0153752 (26)	1.0000000 (26)	.0895562 (26)	.2820281 (26)	.1604224 (26)	-.3254690 (26)	.0998601 (26)	-.0784252 (25)
(4) Student Ability (UPT Score)	-.6165685 (26)	.1828765 (26)	.0895562 (26)	1.0000000 (26)	.1047465 (26)	-.2812378 (26)	.0373923 (26)	-.1433272 (26)	-.0598756 (26)
(5) Aircraft Instructor Index	-.2128723 (26)	.0938033 (26)	.2820281 (26)	.1047465 (26)	1.0000000 (26)	-.2148620 (26)	.1219109 (26)	.0365104 (26)	.0202790 (26)
(6) Aircraft Instructor Variability	.4824783 (26)	.1456245 (26)	.1604224 (26)	-.2812378 (26)	-.2148620 (26)	1.0000000 (26)	.0845465 (26)	.1058289 (25)	-.0165303 (26)
(7) Average Scheduling Time	-.0915943 (26)	.1349154 (26)	-.3254690 (26)	.0373923 (26)	.1219109 (26)	.0845465 (26)	1.0000000 (26)	.3325741 (26)	-.1383922 (26)
(8) Scheduling Variability	.1554045 (26)	.2059962 (26)	.0998601 (26)	-.1433272 (26)	.0365104 (26)	.1058289 (26)	.3325741 (26)	1.0000000 (26)	-.0286261 (26)
(9) Motion	.0995624 (26)	.2865341 (26)	-.0784252 (26)	-.0598756 (26)	.0202790 (26)	-.0165303 (26)	-.1383922 (26)	-.0286261 (26)	1.0000000 (26)

TABLE D-14. SUMMARY TABLE FOR REGRESSION ANALYSIS FOR ASE OFF TAKEOFF

Source	Sum of Squares	df	MS	F
Regression	173.782	3	57.927	7.028*
Residual	181.333	22	8.242	
Total	355.115	25		

*$p < .05$

TABLE D-15. REGRESSION COEFFICIENTS FOR VARIABLES PREDICTING TRIALS TO PROFICIENCY FOR ASE OFF TAKEOFF

Variable	Regression Coefficient	t-Value
Student UPT Flight Score	-.172108	-3.249*
Instructor Variability	16.048473	2.130*
Motion/No Motion	.550076	.486
Constant (Intercept)	31.447474	

*$p < .05$

APPENDIX E

INTERCORRELATION MATRICES, SUMMARY TABLES, REGRESSION COEFFICIENTS AND TESTS OF SIGNIFICANCE FOR "B" STAGE TASKS TRIALS TO PROFICIENCY

TABLE E-1. INTERCORRELATION MATRIX FOR FREESTREAM RECOVERY

	(1) Trials to Proficiency	(2) Simulator Training Trials	(3) Simulator Proficiency	(4) Student Ability (UPT Score)	(5) Aircraft Instructor Index	(6) Aircraft Instructor Variability	(7) Average Scheduling Time	(8) Scheduling Variability	(9) Student Ability (RI Score)	(10) Motion
(1) Trials to Proficiency	1.0000000 (25)	-.4523590 (25)	-.0318101 (25)	-.3776328 (25)	-.6060157 (25)	.3704894 (25)	.1797942 (25)	.3451812 (25)	-.5361282 (25)	.3420498 (25)
(2) Simulator Training Trials	-.4523590 (25)	1.0000000 (25)	-.3737238 (25)	.1758665 (25)	.2577491 (25)	.0837030 (25)	.0106011 (25)	-.0269231 (25)	.3938594 (25)	-.1553112 (25)
(3) Simulator Proficiency	-.0318101 (25)	-.3737238 (25)	1.0000000 (25)	.2133774 (25)	-.0419523 (25)	-.4421667 (25)	-.2932294 (25)	-.3739882 (25)	.0896956 (25)	-.2048685 (25)
(4) Student Ability (UPT Score)	-.3776328 (25)	.1758665 (25)	.2133774 (25)	1.0000000 (25)	.2962704 (25)	-.3706160 (25)	-.1664043 (25)	-.3421485 (25)	.5927620 (25)	-.0883222 (25)
(5) Aircraft Instructor Index	-.6060157 (25)	.2577491 (25)	-.0419523 (25)	.2962704 (25)	1.0000000 (25)	-.6314259 (25)	-.0216815 (25)	-.2094623 (25)	.6149028 (25)	-.0885236 (25)
(6) Aircraft Instructor Variability	.3704894 (25)	.0837030 (25)	-.4421667 (25)	-.3706160 (25)	-.6314259 (25)	1.0000000 (25)	.3063082 (25)	.3919462 (25)	-.5876207 (25)	.2255282 (25)
(7) Average Scheduling Time	.1797942 (25)	.0106011 (25)	-.2932294 (25)	-.1664043 (25)	-.0216815 (25)	.3063082 (25)	1.0000000 (25)	.6928984 (25)	-.0477683 (25)	-.0609601 (25)
(8) Scheduling Variability	.3451812 (25)	-.0269231 (25)	-.3739882 (25)	-.3421485 (25)	-.2094623 (25)	.3919462 (25)	.6928984 (25)	1.0000000 (25)	-.3402769 (25)	-.1038808 (25)
(9) Student Ability (RI Score)	-.5361282 (25)	.3938594 (25)	.0896956 (25)	.5927620 (25)	.6149028 (25)	-.5876207 (25)	-.0477683 (25)	-.3402769 (25)	1.0000000 (25)	-.1242636 (25)
(10) Motion	.3420498 (25)	-.1553112 (25)	-.2048685 (25)	-.0883222 (25)	-.0885236 (25)	.2255282 (25)	-.0609601 (25)	-.1038808 (25)	-.1242636 (25)	1.0000000 (25)

TABLE E-2. SUMMARY OF REGRESSION ANALYSIS FOR FREESTREAM RECOVERY

Source	Sum of Squares	df	MS	*F*
Regression	331.099	2	165.549	9.040*
Residual	402.901	22	18.314	
Total	734.000	24		

*$p < .05$

TABLE E-3. REGRESSION COEFFICIENTS FOR VARIABLES PREDICTING TRIALS TO PROFICIENCY FOR FREESTREAM RECOVERY

Variable	Regression Coefficient	t-Value
Instructor Index	-18.805125	-3.659*
Motion/No Motion	3.173031	1.833
Constant/Intercept	15.850254	

*$p < .05$

TABLE E-4. INTERCORRELATION MATRIX FOR ALTERNATE APPROACH PILOT PROCEDURES

	(1) Trials to Proficiency	(2) Simulator Training Trials	(3) Simulator Proficiency	(4) Student Ability (UPT Score)	(5) Aircraft Instructor Index	(6) Aircraft Instructor Variability	(7) Average Scheduling Time	(8) Scheduling Variability	(9) Student Ability (RI Score)	(10) Motion
(1) Trials to Proficiency	1.0000000 (25)	.2868406 (25)	-.0305286 (25)	-.4702193 (25)	-.1255170 (25)	.3284413 (25)	.3567781 (25)	.2926842 (25)	-.4817029 (25)	-.1538113 (25)
(2) Simulator Training Trials	.2868406 (25)	1.0000000 (25)	-.0497969 (25)	.2782364 (25)	-.1978373 (25)	.0486626 (25)	.2837786 (25)	.2786498 (25)	.0386613 (25)	-.2094128 (25)
(3) Simulator Proficiency	-.0305286 (25)	-.0497969 (25)	1.0000000 (25)	.0764671 (25)	.0626757 (25)	.0854746 (25)	-.1053626 (25)	-.2411072 (25)	.1051920 (25)	-.1115796 (25)
(4) Student Ability (UPT Score)	-.4702193 (25)	.2782364 (25)	.0764671 (25)	1.0000000 (25)	.1013962 (25)	-.1876983 (25)	-.1221079 (25)	.1076659 (25)	.5927620 (25)	-.0883222 (25)
(5) Aircraft Instructor Index	-.1255170 (25)	-.1978373 (25)	.0626757 (25)	.1013962 (25)	1.0000000 (25)	-.1361252 (25)	.1681880 (25)	.0483253 (25)	.1308489 (25)	.1531600 (25)
(6) Aircraft Instructor Variability	.3284413 (25)	.0486626 (25)	.0854746 (25)	-.1876983 (25)	-.1361252 (25)	1.0000000 (25)	.4162854 (25)	.4095297 (25)	-.1978763 (25)	.0645033 (25)
(7) Average Scheduling Time	.3567781 (25)	.2837786 (25)	-.1053626 (25)	-.1221079 (25)	.1681880 (25)	.4162854 (25)	1.0000000 (25)	.7647291 (25)	.0782721 (25)	-.1942894 (25)
(8) Scheduling Variability	.2926842 (25)	.2786498 (25)	-.2411072 (25)	.1076659 (25)	.0483253 (25)	.4095297 (25)	.7647291 (25)	1.0000000 (25)	.1694221 (25)	.0385205 (25)
(9) Student Ability (RI Score)	-.4817029 (25)	.0386613 (25)	.1051920 (25)	.5927620 (25)	.1308489 (25)	-.1978763 (25)	.0782721 (25)	.1694221 (25)	1.0000000 (25)	-.1242636 (25)
(10) Motion	-.1538113 (25)	-.2094128 (25)	-.1115796 (25)	-.0883222 (25)	.1531600 (25)	.0645033 (25)	-.1942894 (25)	.0385205 (25)	-.1242636 (25)	1.0000000 (25)

TABLE E-5. SUMMARY TABLE OF REGRESSION ANALYSIS FOR ALTERNATE APPROACH PILOT PROCEDURES

Source	Sum of Squares	df	MS	F
Regression	53.459	3	17.820	5.353*
Residual	69.901	21	3.329	
Total	123.360	24		

$^{*}p < .05$

TABLE E-6. REGRESSION COEFFICIENTS FOR VARIABLES PREDICTING TRIALS TO PROFICIENCY FOR ALTERNATE APPROACH PILOT PROCEDURES

Variable	Regression Coefficient	t-Value
Student UPT RI Score	-59.430482	-3.446*
Scheduling Variability	.157396	2.396*
Motion/No Motion	- 1.079527	-1.454
Constant (Intercept)	184.893433	

$^{*}p < .05$

TABLE E-7. INTERCORRELATION MATRIX FOR COUPLED HOVER DEPARTURE PROCEDURES

	(1) Trials to Proficiency	(2) Simulator Training Trials	(3) Simulator Proficiency	(4) Student Ability (UPT Score)	(5) Aircraft Instructor Index	(6) Aircraft Instructor Variability	(7) Average Scheduling Time	(8) Scheduling Variability	(9) Student Ability (RI Score)	(10) Motion
(1) Trials to Proficiency	1.0000000 (25)	.2491577 (25)	-.0293009 (25)	-.2617297 (25)	-.3480954 (25)	.4332054 (25)	.2991326 (25)	.2378585 (25)	-.4117963 (25)	.4142032 (25)
(2) Simulator Training Trials	.2491577 (25)	1.0000000 (25)	-.0148723 (25)	-.1217973 (25)	-.2328313 (25)	-.1317335 (25)	-.1420057 (25)	.0006557 (25)	-.2233738 (25)	-.0974230 (25)
(3) Simulator Proficiency	-.0293009 (25)	-.0148723 (25)	1.0000000 (25)	.2513989 (25)	.2177851 (25)	.0982775 (25)	-.0681674 (25)	-.0491486 (25)	.0337699 (25)	-.2211949 (25)
(4) Student Ability (UPT Score)	-.2617297 (25)	-.1217973 (25)	.2513989 (25)	1.0000000 (25)	.1343763 (25)	-.3988508 (25)	-.1425341 (25)	-.5178916 (25)	.5927620 (25)	-.0883222 (25)
(5) Aircraft Instructor Index	-.3480954 (25)	-.2328313 (25)	.2177851 (25)	.1343768 (25)	1.0000000 (25)	-.5386978 (25)	.0426975 (25)	.0873689 (25)	.4128961 (25)	-.0876111 (25)
(6) Aircraft Instructor Variability	.4332054 (25)	-.1317335 (25)	.0982775 (25)	-.3988508 (25)	-.5386978 (25)	1.0000000 (25)	.2078689 (25)	.1503278 (25)	-.6720717 (25)	.1986140 (25)
(7) Average Scheduling Time	.2991326 (25)	-.1420057 (25)	-.0681674 (25)	-.1425341 (25)	.0426975 (25)	.2078689 (25)	1.0000000 (25)	.4122104 (25)	-.0236253 (25)	-.0018819 (25)
(8) Scheduling Variability	.2378585 (25)	.0006557 (25)	-.0491486 (25)	-.5178916 (25)	.0873689 (25)	.1503278 (25)	.4122104 (25)	1.0000000 (25)	-.3488067 (25)	-.1009922 (25)
(9) Student Ability (RI Score)	-.4117963 (25)	-.2233738 (25)	.0337699 (25)	.5927620 (25)	.4128961 (25)	-.6720717 (25)	-.0236253 (25)	-.3488067 (25)	1.0000000 (25)	-.1242636 (25)
(10) Motion	.4142032 (25)	-.0974230 (25)	-.2211949 (25)	-.0883222 (25)	-.0876111 (25)	.1986140 (25)	-.0018819 (25)	-.1009922 (25)	-.1242636 (25)	1.0000000 (25)

TABLE E-8. SUMMARY TABLE OF REGRESSION ANALYSIS FOR COUPLED HOVER DEPARTURE PROCEDURES

Source	Sum of Squares	df	MS	*F*
Regression	112.948	4	28.237	4.718*
Residual	119.692	20	5.985	
Total	232.640	24		

*$p < .05$

TABLE E-9. REGRESSION COEFFICIENTS FOR VARIABLES PREDICTING TRIALS TO PROFICIENCY FOR COUPLED HOVER DEPARTURE PROCEDURES

Variable	Regression Coefficient	t-Value
Motion/No Motion	2.346541	2.324*
Simulator Training Trials	.303545	2.276*
Instructor Variability	8.583558	2.071
Scheduling Time	.166855	1.695
Constant (Intercept)	-2.600568	

*$p < .05$

TABLE E-10. INTERCORRELATION MATRIX FOR SAR SEARCH

	(1) Trials to Proficiency	(2) Simulator Training Trials	(3) Simulator Proficiency	(4) Student Ability (UPT Score)	(5) Aircraft Instructor Index	(6) Aircraft Instructor Variability	(7) Average Scheduling Time	(8) Scheduling Variability	(9) Student Ability (RI Score)	(10) Motion
(1) Trials to Proficiency	1.0000000 (25)	-.1340766 (25)	-.1253740 (25)	-.3514865 (25)	-.3382128 (25)	.1148377 (25)	.1821764 (25)	.1727621 (25)	-.2822229 (25)	-.0451905 (25)
(2) Simulator Training Trials	-.1340766 (25)	1.0000000 (25)	.2112275 (25)	-.0168157 (25)	.2412484 (25)	-.1457246 (25)	.3373656 (25)	.3173960 (25)	.1137597 (25)	-.3762479 (25)
(3) Simulator Proficiency	-.1253740 (25)	.2112275 (25)	1.0000000 (25)	.3598833 (25)	.3482001 (25)	.1515051 (25)	-.1411391 (25)	.0355901 (25)	.1969576 (25)	.0589041 (25)
(4) Student Ability (UPT Score)	-.3514865 (25)	-.0168157 (25)	.3598833 (25)	1.0000000 (25)	.4031387 (25)	.1164174 (25)	.0346260 (25)	.2209353 (25)	.5927620 (25)	-.0883222 (25)
(5) Aircraft Instructor Index	-.3382128 (25)	.2412484 (25)	.3482001 (25)	.4031387 (25)	1.0000000 (25)	-.4478448 (25)	-.0394051 (25)	.1332456 (25)	.2739921 (25)	.0209580 (25)
(6) Aircraft Instructor Variability	.1148377 (25)	-.1457246 (25)	.1515051 (25)	.1164174 (25)	-.4478448 (25)	1.0000000 (25)	.0317612 (25)	.2512160 (25)	-.0824545 (25)	-.2458076 (25)
(7) Average Scheduling Time	.1821764 (25)	.3373656 (25)	-.1411391 (25)	.0346260 (25)	-.0394051 (25)	.0317612 (25)	1.0000000 (25)	.8647662 (25)	.1976921 (25)	-.1082809 (25)
(8) Scheduling Variability	.1727621 (25)	.3173960 (25)	.0355901 (25)	.2209353 (25)	.1332456 (25)	.2512160 (25)	.8647662 (25)	1.0000000 (25)	.2248287 (25)	-.1037601 (25)
(9) Student Ability (RI Score)	-.2822229 (25)	.1137597 (25)	.1969576 (25)	.5927620 (25)	.2739921 (25)	-.0824545 (25)	.1976921 (25)	.2248287 (25)	1.0000000 (25)	-.1242636 (25)
(10) Motion	-.0451905 (25)	-.3762479 (25)	.0589041 (25)	-.0883222 (25)	.0209580 (25)	-.2458076 (25)	-.1082809 (25)	-.1037601 (25)	-.1242636 (25)	1.0000000 (25)

TABLE E-11. SUMMARY TABLE OF REGRESSION ANALYSIS FOR SAR SEARCH

Source	Sum of Squares	df	MS	F
Regression	13.008	9	1.445	1.109(NS)*
Residual	119.552	15	1.303	
Total	32.560	24		

*NS = Not significant

TABLE E-12. REGRESSION COEFFICIENTS FOR VARIABLES PREDICTING TRIALS TO PROFICIENCY FOR SAR SEARCH

Variable	Regression Coefficient	t-Value
Student UPT RI Score	-8.829433	-.635
Student UPT Flight Score	-.031538	-1.053
Instructor Index	-8.395512	-1.595
Instructor Variability	-11.190387	-1.422
Average Scheduling Time	-.145033	-.932
Scheduling Variability	.234433	1.659
Simulator Training Trials	-.636985	-1.476
Simulator Proficiency Ratio	1.297605	1.116
Motion/No Motion	-.764323	-1.308
Constant (Intercept)	44.692668	

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